BIRDS IN WALES

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Front and back cover photographs of a Dipper and Grey Wagtail on the Angidy River near Tintern, Monmouthshire by Kenneth Wilson Smith

Text illustrations by Colin Richards
Welsh translations by Rhion Pritchard
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EDITORIAL

The last issue of Birds in Wales focussed on upland habitats in north Wales, on Peregrines, on the status of bird species in Wales and on declining species of wader as well as of Turtle Dove and Woodlark. This issue focuses on Ring Ouzels, Twite and river birds.

I am delighted to publish the results of Julian Driver's survey of Ring Ouzels in Snowdonia and also of David Smith's work on the species on Cadair Idris. These were excellent pieces of work and they both must have walked hundreds of kilometres in pursuit of the elusive Ring Ouzels. It is very encouraging too to learn that Snowdonia holds a larger population than previously thought and that the Cadair Idris population is also healthy even if the story in the rest of Wales is less satisfactory.

Geoff Gibbs and John Small provide us with some interesting data on numbers of river birds on the Afon Ogwen and they show some interesting changes over the last three decades since Peter Schofield surveyed the river in 1974/75. Some species as Greylag Goose and Goosander have increased; others, as Red-breasted Merganser, Moorhen and Common Sandpiper have declined.

How many birdwatchers have seen Twite in Wales? Ian Johnstone reports on the breeding and wintering status of this small elusive finch in Wales and provides some fascinating information on the plant species that Twites prefer for seed and the general ecology of the species.

The tiny island of Denny out in the Severn Estuary will be known to few birdwatchers in Wales other than those in Monmouthshire and Newport. Richard Clarke's paper will help redress this. I was lucky enough to be part of a team that visited the island on a sunny afternoon in mid June this year to ring Cormorant and Great Black-backed Gull chicks.

I am very grateful to photographer Kenneth Smith of Chepstow for letting me use his lovely photos of an adult Dipper and Grey Wagtail taken on one of my study streams. I just had to have a Dipper on the cover of one volume of Birds in Wales! I thank too Ian Spence for designing the cover.

Erratum: In John Lawton Robert's paper on winter moorland birds in Birds in Wales Vol. he made a mistake on page 120 in the last line of paragraph 2 where 'dawn' should be replaced by 'sunrise'. This is important, because at low densities Red Grouse hardly call at sunrise but do so vigorously at dawn.

Population census of Ring Ouzels *Turdus torquatus* breeding in Snowdonia, 2009-10

Julian Driver

Hafod y Fedwen, Gwyllt Road, Llanfairfechan, LL33 0EG

SUMMARY

After an initial survey in 2008, intensive fieldwork was carried out in 2009 and 2010 between mid April and late July in the northern sector of Snowdonia National Park to locate nest sites of Ring Ouzels. Some 164 territories were found with breeding proven at 47 (29%) and probable breeding at 65 (40%). The greatest concentrations of territories were found on the highest mountain blocks of Carneddau, Glyderau and Snowdon, and particularly on the high precipitous craggy slopes towering over the Nant Ffrancon and Llanberis passes. Density levels could reach 2-4 pairs per occupied km^2.and nests were often only 350-600m apart. Smaller concentrations were also found on the more outlying Mynydd Mawr and Moel Hebog ranges and on the mountains in the Ffestiniog region but at lower densities of 1-2 pairs per occupied km^2.

CRYNODEB

Wedi arolwg ragarweiniol yn 2008, cynhaliwyd gwaith maes dwys yn 2009 a 2010 rhwng canol Ebrill a diwedd Gorffennaf yn rhan ogleddol Parc Cenedlaethol Eryri i ddarganfod nythod Mwyalchen y Mynydd. Cafwyd hyd i 164 o diriogaethau, gyda magu wedi ei brofi mewn 47 (29%) a magu tebygol mewn 65 (40%). Ar fynyddoedd uchaf y Carneddau, Glyderau a'r Wyddfa y cafwyd y nifer fwyaf o diriogaethau, yn arbennig ar y llechweddau serth a chreigiog uwchben Nant Ffrancon a Nant Peris. Gallai dwysedd poblogaeth gyrraedd 2-4 pâr y km^2 lle roedd adar, ac yn aml dim ond pellter o 350-600m oedd rhwng nythod. Cafwyd niferoedd sylweddol hefyd ar fynyddoedd Mynydd Mawr a Moel Hebog ac ar fynyddoedd ardal Ffestiniog, ond gyda dwysedd is o 1-2 pâr y km^2 lle roedd adar.

INTRODUCTION

During recent years population studies undertaken in various parts of Britain have indicated a marked decline in the national Ring Ouzel population (Green 2002, BTO 2010, Sim *et al*.. 2010). An assessment in Wales indicated a 69% decline between 1999 and 2006 in 26 tetrads sampled first in the national 1999 survey (Wotton *et al*.. 2002) and re-surveyed in 2006 (Green 2007). These findings proved most interesting since I had not noted any perceptible decline in the Snowdonia Ring Ouzel population of north Wales during many years of incidental observations whilst carrying out annual Raven censuses (Driver 2006). I also noted that the 2006 Welsh survey had not included any sample tetrads from within the Caernarfon part of Snowdonia and that, apart from a few localised surveys, there does not appear to have been any previous complete census of Ring Ouzels in this region. This lack of reliable information for Snowdonia prompted me to undertake this study, in which the initial priority was to establish the population size and distribution; followed by a more in-depth look at their general breeding biology. At first, I was unsure if this was a feasible undertaking considering the size and ruggedness of Snowdonia, but preliminary census work during 2008 went better than expected and I commenced systematic field work in 2009, which was completed in 2010. Many nest data were also recorded along with notes on breeding behaviour, the results of which will be presented at a later date.

STUDY AREA

The study area lies in north-west Wales and encompasses the northern sector of the Snowdonia National Park, ranging northwards from the Vale of Ffestiniog and west of the Afon Conwy valley. Most of the area lies within the old Watsonian vice-county of Caernarvonshire but includes a small section of northern Meirionnydd in the Ffestiniog area. It is composed of high mountain blocks dissected by deep glaciated valleys and is roughly 35km north to south and 30km east to west. In the north are the mountain ranges of the Carneddau, Glyderau and Yr Wyddfa/Snowdon, whilst to the SW there are Mynydd Mawr, Garnedd Goch and Moel Hebog, and to the SE the Moel Siabod, Cnicht and Moelwynau plus the quarried mountains around Blaenau Ffestiniog. Most of the region lies above 250m, including large areas above 500m, and reaches a maximum elevation of 1085m at Yr Wyddfa summit (Fig. 1). The precipitous mountain slopes are indented by numerous cwms and side valleys with scattered crags and block scree as well as many derelict quarries and mines. At high altitudes the vegetation is mostly impoverished sheep pasture with thin, leached, acidic soils dominated with Mat Grass *Nardus stricta* and bryophytes. At lower levels the montane vegetation grades into extensive areas of *Molinia* and *Festuca-Agrostis* grasslands and enclosed sheep pastures with improved soils. Extensive areas of Heather *Calluna vulgaris* and Bilberry *Vaccinium myrtillus* are found on the steepest rocky slopes and these provide the main nesting habitat for

Ring Ouzels. Large swathes of Heather moor with scattered coniferous plantations found in some low-lying peripheral areas are rarely inhabited by Ring Ouzels. The proximity of these mountains to the western seaboard results in some extreme weather conditions and the region is renowned for being one of the wettest and windiest in Wales.

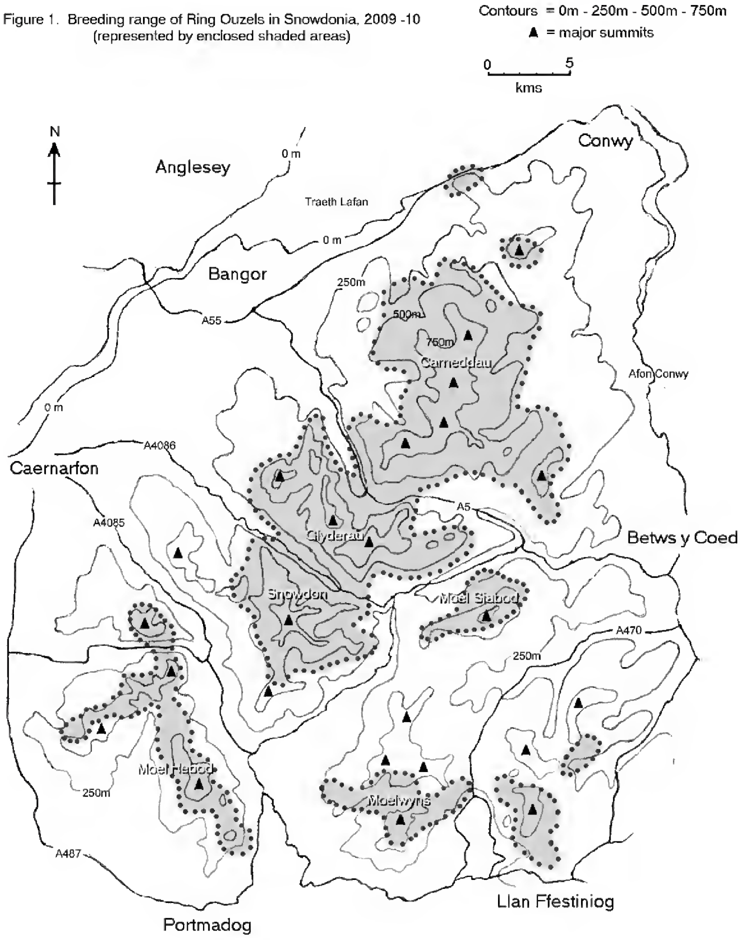

Figure 1. Study area in Snowdonia

METHODS

The main objective was to locate and map all Ring Ouzel nesting sites within the study area by working random transects through all suitable breeding habitats. This usually involved ferreting/scrambling along the steep craggy mountain sides at various levels and working up and down numerous steep gullies. Having a good knowledge of breeding sites from previous years was a distinct advantage and I was also fortunate in that both 2009 and 2010 were two particularly dry seasons with prolonged periods of settled weather. Even so, there were odd days when low cloud or driving rain made field work very unproductive and somewhat hazardous. Due to these problems it was inevitable that some areas received better coverage than others. Most prime breeding habitats were worked during well-spaced multiple visits, usually four or five per season, whilst coverage of subprime peripheral areas was less intense. Exhaustive survey work was undertaken from mid April to late July with a total of 86 field days in 2009 and 83 in 2010. Finding nests was often a matter of chance, usually by flushing sitting females, though on three occasions I was fortunate to locate nests with chicks by tracking adults flying back to their broods with food. Listening for singing males or agitated birds was often the easiest initial means of locating breeding sites. Though it was not always possible to locate a nest, it was usually possible to pinpoint its approximate position and in a few cases to establish the approximate boundaries of the defended territory. All sites were then mapped and photographed, an essential for relocating nests. Confirmation of breeding was rarely easy and breeding sites were categorised under three headings: **A** - confirmed breeding, i.e. occupied nest with eggs or chicks, agitated adults carrying food at a specific location, or by locating recently fledged young; **B** – strong indications of breeding, i.e. agitated pair observed in a specific area and in a suitable nesting situation on more than one occasion with indications of an occupied nest in that vicinity; **C** – probable breeding, i.e. sites where males were heard singing and giving agitated calls at specific locations on more than one occasion but without any sightings of females. In most of these situations it is probable that the females were sitting tight on concealed nests. However, in a very few cases, it was also possible that unattached males may have been holding non-breeding territories. Occasional single sightings of birds seen in potential nesting habitats, including singing males have not been included in the results.

RESULTS

During 2009-10 a total of 164 occupied territories was identified within Snowdonia, with confirmed breeding (category A) in 47 (29%) territories and strong indications of breeding (category B) within another 65 (40%) territories. Of the remaining 52 (32%) of occupied territories (category C) there were regular sightings of singing males at specific locations with occasional agitated behaviour but observations were insufficient to validate breeding. There were also many scattered sightings of birds, particularly during the first half of the season, that were considered to be either wandering non-established birds or migrants. These included sightings of singing males or small groups of foraging birds (often paired birds) in non-breeding areas that would also engage in frequent squabbling.

Of the 164 territories, 115 (70%) were located within the central mountain massif region of Carneddau/Glyderau/Snowdon, 21 (13%) on the mountain ranges in the SW, and 19 (12%) on the mountains to the SE. There were also another nine (5%) territories in peripheral areas. The annual totals of occupied territories were 125 during 2009 and 137 during 2010. Of the 2009 territories 98 (78%) were reoccupied during 2010, seven were considered to be definitely unoccupied, and another 16 sites apparently unoccupied. There were also four sites from 2009 that were not revisited during 2010. An additional 39 new territories were located during 2010, mostly in areas not covered before. For this analysis I have therefore taken 137 and 164 to be the minimum and maximum number of occupied territories recorded during the study period.

There was a distinct pattern in the distribution of breeding pairs (Figure 1) with the most densely populated areas situated centrally on the highest mountain blocks of Carneddau, Glyderau, and Snowdon, and particularly on the high precipitous craggy slopes towering over the Nant Ffrancon and Llanberis passes. A noticeable feature was the close grouping of breeding pairs in localised areas where density levels could reach 2-4 pairs per occupied km^2. Within groups spacing between nests was often 350-600m with both a vertical as well as horizontal aspect. Smaller concentrations were also found on the more outlying Mynydd Mawr and Moel Hebog ranges and on the mountains in the Ffestiniog region but at lower densities of 1-2 pairs per occupied km^2.

Because of this clumping, attempts to establish overall population densities in relation available habitat were difficult. Even in the core areas there were large areas of suitable habitat that were totally unpopulated. In an attempt to illustrate the relative population densities found in each region, I have compared (Table 1) the number of occupied 1x1 km squares with the approximate number of squares that had suitable breeding habitat. For the entire study area a total 116 of the 480 (24%) such squares were occupied. Not surprisingly, the high ranges of the Carneddau, Glyderau and Snowdon held most of the occupied kilometre squares. There, 25-44% squares were occupied whilst the south-east region had the lowest frequency (14%). Based on minimum/maximum population figures there was an average density level of 1.2 to 1.4 pairs per occupied square. Of the unpopulated areas the most noticeable gap was a large swath of rugged mountainous uplands stretching eastwards from the Nantgwynant to the Upper Lledr valley and across to Cwm Penmachno. Since there have been many scattered breeding records in this region during previous years it seems likely that some pairs may well have gone undetected there during 2009-2010.

Table 1. Number of occupied one kilometre squares compared to the total number of available squares with potential breeding habitats in each region.

Mountain Regions	Number of 1 km squares with potential breeding habitat	Number of occupied 1 km squares (%)
Carneddau	148	37 (25)
Glyderau	57	25 (44)
Snowdon/Yr Wyddfa	75	21 (28)
South-west (Moel Hebog/Mynydd Mawr)	73	15 (21)
South-east (Moel Siabod/ Moelwyns/ Ffestiniog)	128	18 (14)
Totals	480	116 (24)

Territories were found in a wide altitudinal range (200-900m), though the majority (84%) were located between 350m and 700m (Figure 2). The mean altitude was 530m; using the nest or approximate nest position as the reference point. The lowest nest was at about 200m, in a coastal quarry, and the highest was at 900m on crags just below a summit on the Carneddau. It should be noted that on the highest mountain slopes the population has a three-dimensional vertical aspect; pairs may breed almost above one another at different levels, thus showing identical grid references!

Most nest sites were well concealed on steep Heather covered craggy slopes and usually close to well grazed sheep pastures that are important foraging areas. There were also a few atypical nest sites in more open, exposed situations well beyond the Heather zones. For example, some pairs were found with nests under rocks in extremely exposed situations close to mountain summits on both the Carneddau, as mention above, and the Glyderau at 880m.

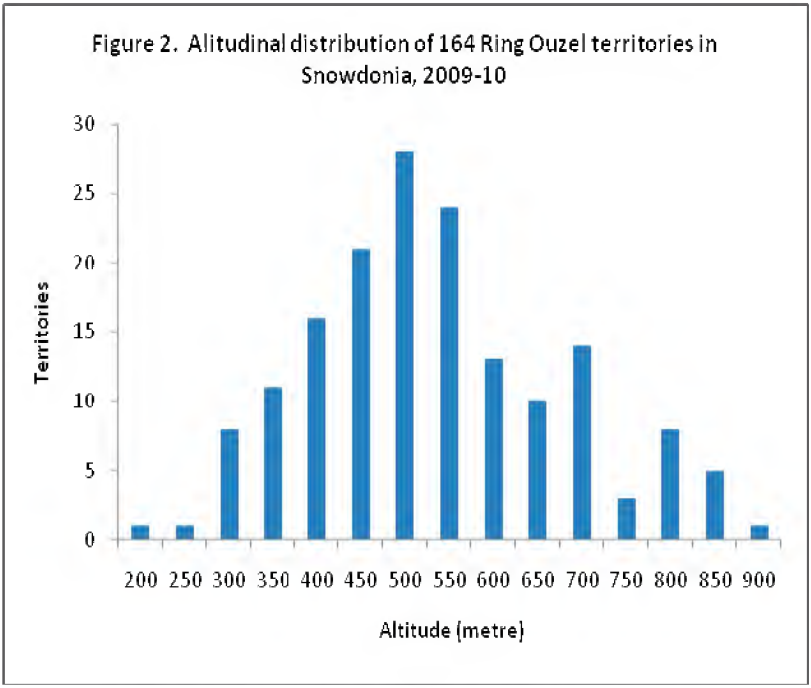

Figure 2. Altitudinal distribution of 164 Ring Ouzel territories in Snowdonia, 2009-11

Sometimes nesting areas were abandoned but only to be re-occupied at some later date. For example, in an isolated cwm on the Glyderau range that had been occupied by one to two pairs for some years before this census, the site was found to be unoccupied during 2008 and 2009 but was reoccupied by three breeding pairs during 2010.

The amount of singing that individual males engaged in varied greatly. Some males were persistent singers whereas at the majority of sites singing was much more sporadic. For example, at a nest site in the Ogwen Valley that was occupied for four years 2008-2010, it was not until 2010 that I heard the male singing for the very first time despite many visits. Had I not first chanced upon the nest itself during 2008, it is highly probable that this particular breeding pair would have remained undetected.

DISCUSSION

The results of the 2009-2010 census strongly suggest that Snowdonia could be the most densely populated region of Wales for Ring Ouzels and that, in comparison to the significant declines elsewhere, breeding numbers appear to be relatively stable. Based on minimum and maximum figures, Snowdonia held an estimated 137-164 occupied breeding territories/pairs. However, some isolated pairs were probably overlooked in marginal areas, while even in the well worked core areas odd pairs may also have gone undetected. I suspect that I located about three-quarters of all breeding pairs which, if correct, would equate to an estimated total population of 183-219 pairs. There has been no previous complete census of this species in Snowdonia, just a few localised surveys. Lovegrove *et al.*. (1994) suggested a population of 95-120 pairs within the old county of Caernarfon, which incorporated most of the present survey area as well as the Lleyn Peninsula where a few pairs breed. In comparison, the 2009-2010 census found 121-146 breeding pairs within the Caernarvonshire sector of Snowdonia, plus another 16-18 in adjoining northern Merioneth. These figures indicate that the Ring Ouzel population within the old county of Caernarfon has not declined; it may even be larger than it was 20 years ago.

A number of potential confounding factors influencing census accuracy were recognised during the field work. All such cases have been accounted for in the results. There was a possibility of duplication of a few sites due to established pairs relocating their nest sites beyond their previous territorial boundaries either between years or during repeat nesting within a single season. Thus, a few nesting pairs were discovered late in the season in previously worked areas where there had been no contacts and which otherwise were difficult to account for unless they had gone undetected during earlier visits or, perhaps, were newly established late-settling pairs making their first nesting attempts. Apparently unmated roving birds, particularly males, were often observed during the nesting period some of which might not mate and settle down to breed until later in the season; or some may not breed at all.

Difficulties were also encountered where pairs nested particularly close together and where territorial boundaries could be difficult to recognise. Territorial skirmishing was frequent in such areas and though this was mostly between neighbouring pairs there were occasional skirmishes with intruding non-breeding birds. Plotting territories in these areas could therefore be difficult and some sites may have gone undetected. In addition, pairs nesting in densely populated areas often shared feeding grounds and at considerable distances from their nest sites. For example, one pair were seen making high level flights to a foraging area of sheep pasture more than 1km from their nest and returning repeatedly with food items, possibly worms. This particular foraging area was also shared by at least two other neighbouring pairs.

One aim of this census was to try and establish a reasonably accurate baseline for measuring any population changes that might occur and personally to repeat this census in about 10 years. However, considering the size of the study area, the extreme terrain and the fact that this was a dedicated full-time project requiring considerable fitness and stamina, this objective might prove difficult to achieve. This was a without doubt a challenging project in which no methodical survey technique could be used. Working fixed transects was not an option; and relying entirely upon singing males as indicators for occupied territories would have produced underestimates as many sites would have gone undetected. It should also be noted that had this census been attempted during unsettled and extremely wet summers then the population could have been significantly under-recorded. It is even doubtful that it could have been undertaken in such adverse conditions (not uncommon in these mountains). Repeating this census 'like for like' could therefore be problematic.

When assessing any future population changes it would also be essential to take account of natural population fluctuations. General observations over many years indicate this is a dynamic population in terms of nesting locations and distribution. Even seemingly prime breeding areas can be deserted in some years.

With regards to the future prospects of the Snowdonia Ring Ouzels, no serious threats were recognized other than those that might be created by increased human activities in what is a major tourist park. Ring Ouzels do appear to be particularly sensitive to human disturbance as indicated by the fact that they usually nest only in relatively inaccessible places where disturbance is minimal. In the core breeding areas the increasing popularity of recreational activities such mountain walking and rock climbing could cause greater disturbance to nesting birds in the future as many of these people now aspire to forage more challenging routes on the mountains.

During recent years there has also been increasing disturbance from RAF helicopter training flights that often involve prolonged periods of ground-based hovering over crags and mountainsides in prime breeding areas and which could result in some nesting areas being abandoned. On many occasions I have observed, from a distance, helicopters hovering very close to known nest sites for ten or more minutes and often returning to the same areas. During one particularly disturbing incident at a quarry nest site above Cwm Croesor, a helicopter descended over a quarry waste tip on which I had been watching a brood of newly fledged youngsters being attended by their parents. The pilot had obviously not seen me sitting amongst the Heather. I ran towards the Helicopter gesticulating violently. The pilot eventually spotted me and immediately lifted off but despite a thorough search of the area I was unable to locate any of the brood which must have been scattered far and wide by the downwash of the rotor blades. This is perhaps an extreme example but my observations suggest that such helicopter manoeuvres are becoming an almost daily occurrence in Snowdonia and will undoubtedly cause serious disturbance to all ground nesting birds.

There is one other human factor that could have consequences over the long term, that of reduced stock numbers of mountain ewes and the effects of reduced grazing of mountain pastures, a policy that is being supported by conservational organisations. Short-cropped, heavily grazed, grasslands appear to be important foraging areas for breeding Ring Ouzels. Consequently, increased vegetation cover or changes in plant communities could have some detrimental affects should this policy become too intensive.

No natural threats were identified that might affect the population in the future. The substantial increases of potential predators such as Ravens, Buzzards, Foxes and Badgers that have occurred in Snowdonia during recent years do not appear to be having any detrimental effect on nesting Ring Ouzels. Conversely, the Peregrine, which probably poses the greatest threat to the adult birds, judging from the number of occasions when I have found Ring Ouzel remains on plucking perches near eyries, has declined noticeably during the past decade and now poses a much lower threat. The Peregrine decline in Snowdonia is almost certainly linked to reduced availability of racing Pigeons, as judged by a lower frequency of kills around breeding sites; an occurrence recently documented in parts of central Wales (Dixon *et al.*. 2010).

Despite the considerable losses reported else where in Wales, at least here in Snowdonia Ring Ouzels are continuing to thrive and they appear to be well adapted to survive in places with rigorous spring and summer weather conditions. There is no information on annual variations in breeding productivity in regard to different weather conditions, or for overwinter survival of young birds and adults. Thus, predicting possible population responses to any future climatic fluctuations would be premature and speculative.

ACKNOWLEDGEMENTS

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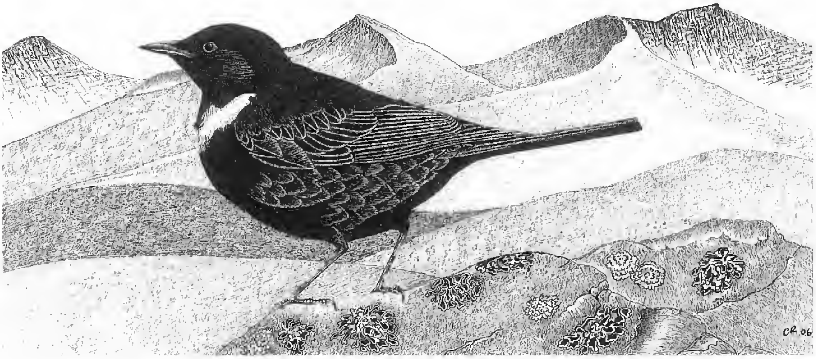

Status of the Ring Ouzel *Turdus torquatus* on Cadair Idris in 2008

David Smith

Glennydd, Springfield Road, Dolgellau, Gwynedd, LL40 1LY

SUMMARY

A survey for Ring Ouzel territories was conducted on Cadair Idris between mid-April and the end of June in 2008. Using various methodologies, all suitable habitats above the 300m contour on the massif were searched, though particular effort was targeted at previously known or suspected territories. 23-25 territories were located with breeding confirmed at six, probable breeding at 17 and possible breeding at two. Territories were well distributed across the massif, though with an obvious concentration noted in Cwm Cau. Overall breeding density recorded was 1.5 pairs/km², increasing to 7.1 pairs/km² within the breeding concentration in Cwm Cau. Steep terrain on the main escarpment with extensive mature heather cover was strongly favoured for breeding habitat. Overall population size was strongly comparable to that in 1999, though a concentration of site vacancy was noted in the eastern and south-eastern regions of the survey area. Use of tape playback was found to be by far the most effective method of survey.

CRYNODEB

Cynhaliwyd arolwg o diriogaethau Mwyalchen y Mynydd ar Gadair Idris rhwng canol Ebrill a diwedd Mehefin 2008. Gan ddefnyddio gwahanol ddulliau, chwiliwyd pob cynefin addas uwch na 300m ar y mynydd, er i ymdrech arbennig gael ei wneud i chwilio am diriogaethau oedd yn hysbys neu a amheuid o'r blaen. Cafwyd hyd i 23-25 tiriogaeth, gyda magu wedi ei gadarnhau mewn chwech ohonynt, magu tebygol mewn 17 a magu posibl mewn dwy. Roedd tiriogaethau ar wasgar ar draws y mynydd, ond gyda nifer uchel yng Nghwm Cau. Dros y mynydd i gyd roedd 1.5 pâr//km², yn cynyddu i 7.1 pâr/km² yng Nghwm Cau. Y cynefin a ffefrid ar gyfer magu oedd llechweddau serth ar y prif grib, gyda llawer o rug yn ei lawn dŵf. Roedd y boblogaeth ar y cyfan yn debyg iawn i 1999, er i nifer o diriogaethau gweigion gael eu nodi yn nwyrain a de-ddwyrain yr ardal a archwiliwyd. Defnyddio tâp oedd y dull mwyaf effeithiol o gynnal arolwg o bell ffordd.

INTRODUCTION

The Ring Ouzel *Turdus torquatus* is a characteristic bird of moorland and montane areas in the UK. Highest breeding densities occur in the Pennines, Lake District, Southern Uplands, Grampians and Western Highlands (Gibbons et al.. 1993). Whilst still widespread, declines in these breeding populations have been reported from as early as the beginning of the last century (Holloway 1996). In recent times, a UK survey in 1999 found an absence of birds in 39-43% of tetrads previously occupied in 1988-91 (Wotton *et al.*. 2002). Comparisons of population estimates for that survey and the 1988-91 Atlas, suggested a population decline of 58%.

In Wales, breeding has been historically recorded in all but one of the vice-counties, traditional strongholds being the Brecon Beacons and Snowdonia National Parks. The RSPB estimated a population of no more than 600 pairs in the early 1970's, being revised downwards by the late 1980's to 450-500 pairs and further again by 1994 to 365-425 pairs (Lovegrove *et al.*. 1994). More recent assessments have suggested widespread declines in all areas and local extinctions in some marginal populations (Green, J. 2002). A Countryside Council for Wales survey of North Wales in 1995 recorded the species in only 26 of the 52 tetrads occupied during the 1988-91 Atlas survey, suggesting a severe decline (Green, J. 2002).

The survey conducted in 2006 re-visited 26 of the 35 tetrads covered in Wales during the 1999 national Ring Ouzel survey. Maximum numbers of breeding pairs in these tetrads had fallen from 81 to 25, a 69% decline (Green 2007). Losses were recorded in all areas, including the traditional strongholds. Clearly, a further downwards and concerning re-assessment of the Welsh population estimate was required.

Merioneth has long been considered a stronghold for the species, holding the highest concentration of breeding pairs in Wales, based on previous population estimates (Lovegrove *et al.*. 1994). Extensive areas of apparently suitable habitat remain in the Rhinogau, Arenig and Aran mountain ranges, with a number of pairs also known to use the Ffestiniog quarry complexes. RSPB surveys, largely conducted during the 1990's, have also revealed the importance of Cadair Idris for this species, with 22-27 territories recorded here in 1999 (A. Young, pers. comm.). Again, recent survey effort recorded severe losses even in these core populations, with the 2006 survey suggesting a 69% decline in the 17 Merioneth tetrads surveyed (Green 2007).

This survey aimed to make a thorough assessment of the current distribution of the species on the Cadair Idris massif, this population being of note in both a local and national context.

METHODS

Design:
An analysis of previous survey data was conducted. Few data were available for Cadair Idris pre-1999, though a good data set exists for both 1999 and subsequent repeat surveys on the mountain. Grid references were plotted and territories (confirmed, probable and possible) mapped, using the standard survey criteria for the species (Gilbert *et al.*. 1998). Survey focussed on these territories, though endeavouring to cover all apparently suitable habitats above the 300m contour. The survey area extended from Mynydd Gwerngraig in the east, across the main massif, from Mynydd Pentre in the south and Mynydd Tan-y-Gader in the north, reaching westwards to the isolated crags of Braich Ddu.

Field Methods:
Three methodologies were adopted. Firstly, from mid-April onwards, suitable habitat was walked, with the aim of eliciting a response from territorial birds. Transect lines were chosen at the base of the cliffs and escarpments, where typically scree and broken ground met short sward grassland and heath mosaics below. Secondly, watch-points were selected where topography allowed an extensive area of habitat to be watched and listened to for Ring Ouzel activity. Watches were conducted in calm weather conditions, extending for a minimum one hour period. Lastly, from mid-May, a tape-lure was used to mount additional searches of previously occupied areas and other suitable habitat. This was conducted both, where other methods had been unsuccessful and to confirm occupancy of territories suspected earlier in the survey.

RESULTS

Coverage:
The survey was conducted between 5th April and 30th June. Fine weather allowed good coverage of the survey area. A total of 24 visits were made to the mountain. This allowed at least two visits to all previously confirmed, probable and possible territories. All other suitable habitat within the survey area was searched on at least one occasion, using the tape-lure. Timing of visits varied, none earlier than 08.00 hrs and none later than 19.00 hrs with the vast majority of survey work being conducted in the late-morning to early-evening period.

Territories:
23-25 territories were located. Using the standard criteria, breeding status was confirmed at six of these sites, probable at 17 and possible at two (see Fig.1).

Of the six confirmed breeding sites, fledged young were recorded at two, adults seen carrying food to nests at the remaining four. Of the probable breeding sites, pairs were recorded at 10, highly agitated alarming males at five, singing noted at the remaining two sites on at least two dates, a week or more apart. The two possible territories related to single registrations of singing males in suitable habitat.

Approximately 15.85km² of suitable breeding habitat was surveyed, generating an overall breeding density of 1.5 pairs/km² (discounting the two possible territories). An obvious breeding concentration was noted in the upper reaches of Cwm Cau, where eight territories were recorded in c.1.12km², a density of 7.1 pairs/km².

Spacing of the territories was variable, the marked concentration of breeding pairs in Cwm Cau being notable, though some pairs breeding in relative isolation up to 2.7km from the nearest neighbours. Overall, mean nearest neighbour distance was 652m (range 180-2700), this reducing to 337m (range 180-530) within the Cwm Cau breeding concentration.

Territory Habitat Selection:
22 of the 25 possible territories were all associated with the steep, broken terrain and mature Heather *Calluna vulgaris* cover of the main ridge escarpment. These areas typically held crags or larger cliff faces, broken by steep-sided, well-vegetated gullies and scree fields, being inaccessible to or less-favoured by, grazing livestock. Mature heather cover available on lesser, undulating gradients, was not found to be selected for breeding sites. The three territories found at lower elevations, away from the main escarpment, all held habitat replicating that of the other territories, with mature, tall Heather and exposed rock both strong features, one of these territories notably occurring in a small disused quarry. As described below, two nest sites were confirmed in gullies running down the steep faces of the ridge escarpment and this topographical feature was strongly suspected to hold nest sites in at least another 13 territories.

Nests:
No concerted effort was made to find nests during the survey, though five were located. Two almost certainly involved the same pair, using a small disused quarry in the southern region of the massif, the first observed in early-May and the second in late-June. The first site was located on steep, well-vegetated landslip above the old quarry face, in deep Heather and beneath a small, slightly overhanging rock outcrop. The second was very low, again in mature Heather at the base of a small rock-face, a short height above the quarry floor, easily reached by a short scramble up loose scree. An older nest structure was found less than a metre away from the second site, in an identical location. Two nests were found in steep gullies on the main ridge escarpment. Both were located high in the gully, on small shelves on the gully sides, where both mature Heather cover and overhanging rock structures provided shelter and concealment. Again, at the one site, an older nest structure was found less than a metre away from the active nest, in an identical situation. The fifth

nest was found on a small crag towards the base of a larger, broken cliff complex. The nest was located on a Heather covered ledge which bisected the crag, a slightly over-hanging rock face above again affording shelter and concealment.

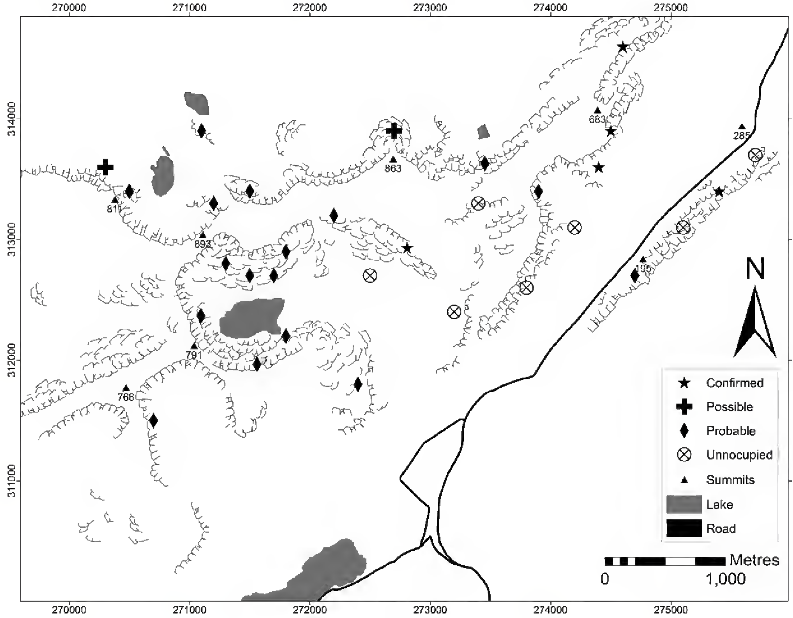

Figure 1. Ring Ouzel territories on Cadair Idris

The figure above does not show the Tyrrau Mawr territory' - a confirmed territory some 3km to the east on the massif.

Altitude and Aspect

Altitude of the occupied territories ranged widely from 270 to 750m, giving a mean of 587m. Over two-thirds (68%) were located above 600m however, with only four recorded at an elevation of less than 500m. Aspect varied, probably dictated by topography rather than any active selection by the birds. 48% of the territories held northerly aspects, 40% southerly, the remaining facing due east.

DISCUSSION

Territories

The results of the survey are encouraging, with results strongly comparable to the 1999 survey, producing territory numbers from 23 to 25 and 22 to 27 respectively. A high degree of site fidelity is commonly recorded amongst Ring Ouzel populations (Burfield 2002) and 16 of the 22 confirmed/probable territories occupied in 1999 were again occupied in 2008. Two of the five possible 1999 territories were also occupied in 2008. Two previously unrecorded confirmed/probable territories in 2008 were in areas not covered in 1999. The inter-annual mobility recorded in some populations (Poxton 1986), or population fluctuation, could account for the absence of birds in six of the confirmed/probable territories in 1999. It should be noted however, that a concentration of this site vacancy in the eastern and south-eastern sectors of the massif, along the flanks of Cwm Rhwyddfor, may be a cause for concern and any future survey effort should attempt to ensure good coverage in these areas. This is perhaps of particular note considering much of this area is now subject to agri-environment agreements, with subsequent modification of grazing regimes. Interestingly, of six territories recorded on Cadair Idris in the late 1960's (P. Hope-Jones, pers comm.), five were still being used in 2008, the sixth only a short distance from another active site, this again hinting at the strongly traditional nature of breeding site usage by the species.

Overall breeding density (1.5 pairs/km^2) is low compared to figures quoted for core populations in Scotland for instance, where densities of c.5.4 pairs/km^2 have been recorded (Rebecca 2001). They are favourable when compared with figures given previously for other areas of Merioneth however, with Hope-Jones recording an overall density of ca. 0.3 pairs/km^2 on the Rhinog Mountains (Hope-Jones 1979). On a more local scale, the breeding concentration within upper Cwm Cau (7.1 pairs/km^2) far exceeds the breeding concentrations given by Hope-Jones for the Rhinogs (1.3-1.5 pairs/km^2) and is comparable to those quoted previously for other areas such as Yorkshire, with 10 nests within 1.3km^2 (Hosking & Newberry 1946) and in the Pentland Hills where up to 13 pairs were found along ca. 2.8km of valley (Durman 1978).

Habitat selection for nesting appears well defined on Cadair Idris and is consistent with that recorded in other studies (Sim *et al.*. 2000). The steepest, craggy ground on the main escarpment is favoured, where mature heather cover is abundant and rock faces and gullies particularly, provide opportunity for nest concealment and protection, as well as providing clear vantage. Interestingly a pair, were observed repeatedly mobbing a Stoat *Mustela erminea* on steep ground, at 550m in Cwm Cau on one occasion during this survey, this incident perhaps illustrating one factor in breeding site selection here, with stoats known to be a predator of the species (Burfield 2002).

Altitudinal range on Cadair Idris is interesting. Flegg and Glue (1975) reported that 82% of Ring Ouzel nests recorded on nest record cards between 1944 and 1970 were found between 230m and 530m above sea level, with 9% falling both above and below these limits. The 1999 national survey for the species (Wotton et al. 2002) found 71% of territories located to be within the 230-530m range, though only 1% being below 230m and 28% above the 530m mark. 65% of the territories recorded during this survey lay above 530m, none falling below 270m. This may purely be a function of topography, with the vast majority of favoured escarpment breeding habitat lying above the 450m contour on the massif, though it may be worth noting perhaps, that all of the six vacant confirmed/probable 1999 territories fall below 450m. Further surveys are required to detect any long-term significance of this.

Broader scale habitat selection for establishment of home ranges is less easy to define and would require more detailed analysis and observation. A preference for grazed pasture for foraging habitat amongst breeding populations has been well documented (Burfield 2002). Historically high sheep grazing levels on Cadair Idris have ensured that this habitat is well distributed across much of the massif, with much unimproved pasture cloaking valley bottoms, slopes and summit plateaux.

Within Cwm Cau, males were observed foraging on short vegetation both above and below the escarpment nesting areas. Males were observed feeding on the areas of short-sward grassland around Llyn Cau on a number of occasions, an uneasy truce allowing two males to utilise the same pasture on occasion, suggesting this may represent some of the better foraging habitat available. The fringes of the summit plateaux appeared to be utilised by foraging males, again where vegetation is generally short, holding a mosaic of acid grassland and *Vaccinium myrtillus* type heath. Foraging was also observed on small open flushes or springs, amongst the tall vegetation on the escarpment and amongst bracken stands later in the breeding cycle, though this latter behaviour may function as a requirement for brood concealment as much as optimal foraging activity. As recorded elsewhere in Wales (Tyler & Green 1994), males were recorded travelling some distance from breeding sites to favoured foraging areas, up to 850 metres on one occasion. These observations suggest that home ranges on Cadair Idris may be quite extensive, extending well beyond the escarpment nesting territory and encompassing a range of habitat types which provide varied foraging opportunities and other functions at various stages of the breeding cycle, such as brood concealment for instance.

Field Methods
Comparison of survey methods was interesting, with use of the tape-lure being by far the most effective survey technique (this method also being employed during the 1999 RSPB survey of the mountain). Early searching, through watching and listening was largely unproductive and hugely under-estimated the number of occupied territories. These methods are generally reliant on detection of vocal activity, which tends to be sporadic. Few territories were located by flushing birds during survey walks, probably due to the scale of the survey area, probable home range size and the precipitous nature of the nesting territories. Detection of occupancy on areas of the mountain, in broad-scale terms was generally possible using these methods, given time and favourable weather conditions. Establishing the actual number of occupied territories within any given area required far more detailed observation, using playback. This proved a highly effective method of mapping territories, particularly where breeding concentration was high. Careful usage at previously known territories, between suspected close territories and in new areas of search all proved productive. Response times were generally low and rarely greater than twenty minutes, when short bursts of playback and listening were employed. Care is required when using this method, as some males proved highly aggressive and prone to relocation, approaching to within a short distance on occasion, though were always found to retreat quickly once the tape was stopped, often returning to favoured singing posts within the breeding territory to call and sing. The response to playback generally involved the male, though occasionally a pair responded together and rarely, a silent female alone, this behaviour always suspected to be in close proximity to the nest.

Conclusion

The results of this survey give cause for cautious optimism, suggesting a relatively stable population over a ten-year period and perhaps emphasizing the importance of Cadair Idris as a probable stronghold for the species in this area of Wales. Site vacancy in some regions of the mountain is a possible cause for concern, though further surveys are required to assess any long-term significance of this. Breeding concentration within the Cwm Cau region suggests this area represents good Ring Ouzel habitat and a fine-scale analysis of home range utilisation within this area may provide a sound understanding of the species' requirements in this part of their range. Survey for the species in this type of habitat is difficult and time consuming and the use of tape playback proved essential for determining the extent and quantity of territory occupancy during this survey.

ACKNOWLEDGEMENTS

I am indebted to Andy Young and Simon Wotton of the RSPB, who provided detailed site data from previous RSPB surveys. Thanks also to Jan Baylis, Mick Green and Jack Grasse who passed on their sightings for the year and to Josh Brown for production of the map.

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Breeding Birds of the Ogwen River Corridor, North Wales, in 2005-7

Geoff Gibbs[1], John Small and Peter Schofield

[1]Fron Wen, Valley Road, Llanfairfechan, LL33 OWT

SUMMARY

The Afon Ogwen flows from Llyn Ogwen (300m asl) through a variety of terrain, to its mouth at Aberogwen on Traeth Lafan at the north-east end of the Menai Strait. We describe here a breeding season survey of the riparian species along the river over three years, and draw some comparisons with surveys carried out by the third author in 1974/5.

CRYNODEB

Llifa Afon Ogwen o Lyn Ogwen (300m uwch lefel y môr), trwy diriogaeth amrywiol i'w haber (Aberogwen) yn rhan ogledd-ddwyreiniol Afon Menai. Yma, disgrifiwn arolwg yn ystod y tymor nythu o rywogaethau'r glannau dros dair blynedd, gan gymharu ag arolygon a wnaed gan y trydydd awdur yn 1974/5.

Nant Ffrancon valley (Section 2 – looking downstream from the upper end)
Photo: Geoff Gibbs

STUDY AREA

Description of the river sections
The river can be divided into the following sections (lengths as measured along banks):

1. A short stretch (600m) from Llyn Ogwen (altitude 300m) almost immediately tumbling 80m down Rhaeadr Ogwen falls to the upper end of the Nant Ffrancon;

2. The U-shaped Nant Ffrancon down to Pont Ceunant, with rough grazing, wet areas and one piece of woodland, also several side-streams (not surveyed), mainly on the west bank (6.5km, vertical fall 20m);

3. A varied stretch from Pont Ceunant (bridge and short gorge at 200m asl), with much woodland, then running below the slate waste tips from Penrhyn Quarries, over Ogwen Bank weir and falls, followed by a flatter stretch past Bethesda and finally under Halfway Bridge and down to Cochwillan Mill (length 6km, vertical fall 160m);

4. From the Mill, almost immediately under the A55, the coastal railway and the lowest road bridge, then through the woodland and improved pastures of Penrhyn Park to reach Traeth Lafan (Lavan Sands) at Aberogwen (length 3km, vertical fall 40m).

METHODS

Although there is little public access along the river, gaining access was in fact fairly straightforward. The upper end of Section 2 was CROW Act access land, below which the land was mostly National Trust tenanted farms. Penrhyn Estate kindly gave access from Halfway Bridge down to Aberogwen.

Visits were planned with two per month from March to May. The final visit to Sections 1 and 2 was deferred until mid-June, so that waders with chicks could be recorded. There was a late spring in 2006 and first visits were delayed by two weeks. Fieldwork was carried out by the authors, walking along or close to the bank wherever possible. The waterfall in Section 1 was viewed from above (the A5 bridge) and from the basin at the foot of the falls. Birds were mapped using standard BTO Waterways Bird Survey (WBS) codes. Visits usually started by 08.00hrs and finished by 13.00hrs.

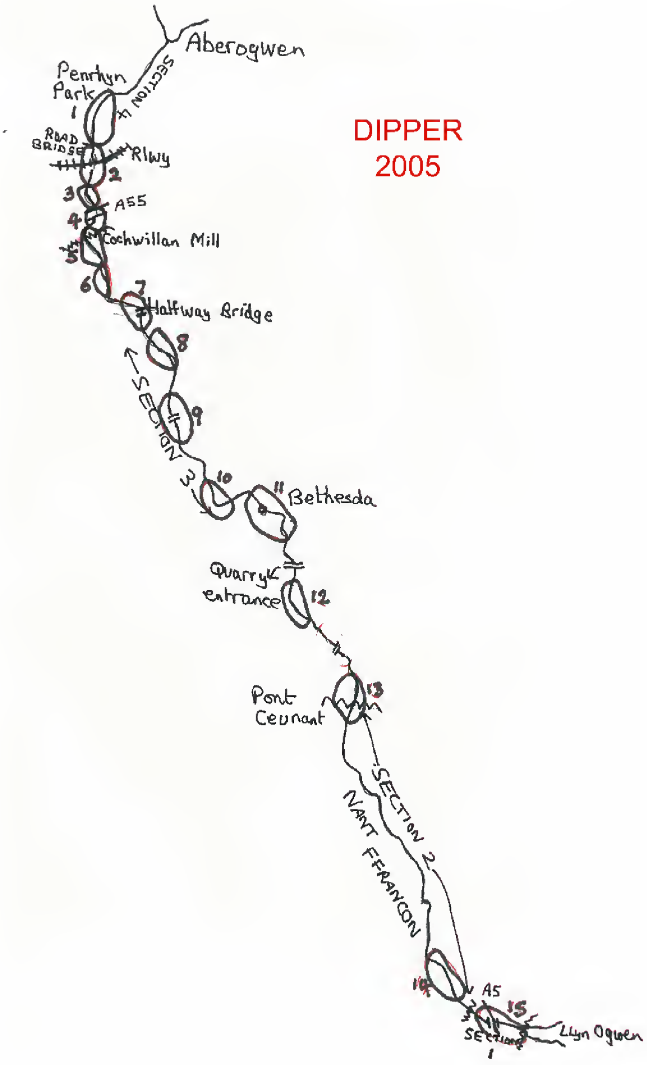

Figure 1. Map of study area showing sections and Dipper territories in 2005
Territories were worked out following WBS criteria, but with two registrations rather than three being the minimum for a territory, because only six visits were made.

RESULTS

Numbers of territories for Common Sandpiper *Actitis hypoleucos*, Grey Wagtail *Motacilla cinerea* and Dipper *Cinclus cinclus* were as follows (Table 1):

Table 1. Numbers of territories of three riparian species, 2005-2007

Species	**2005**	**2006**	**2007**
Common Sandpiper	5	4	4
Grey Wagtail	14	12	14
Dipper	15	14	14

Distribution of the above species
Common Sandpiper: Confined to Nant Ffrancon (Section 2). This species was rather difficult to pin down early in the season, but became easier once adults were attending small young.

Grey Wagtail: Not breeding in Section 2, but otherwise regularly spaced along the river. Additional pairs were likely to be present along side-streams which were not surveyed.

Dipper: Rather patchy in Section 2, with territories varying from nil (2005) to two (2007); one pair recorded on the Ogwen in this section were probably nesting on a steep side-valley on the west side. Regularly spaced along the remainder of the river, except for the last section through Penrhyn Park where birds were absent.

Other riparian species recorded
Greylag Goose *Anser anser*: apart from a pair near Aberogwen in 2005, recorded from Sections 2 and 3 only. Most records came from the upper part of the Nant Ffrancon, with up to five individuals in 2005 and fewer in 2006/7. The species was probably breeding but no broods seen.

Shelduck *Tadorna tadorna*: a pair was close to Aberogwen in 2005.

Mallard *Anas platyrhynchos*: small parties were present along the full length of the river.

Red-breasted Merganser *Mergus serrator*: most sightings in Section 4; the highest upstream was in the middle of Section 3. In 2005 there were two or three pairs, with two broods seen on the final visit. There was only a single sighting in 2006, and one pair, plus a single male, in 2007.

Goosander *Mergus merganser*: this species was very mobile along the river during early visits. In 2005 there were possibly five pairs with at least three broods seen, including a duck with 12 young in the upper Nant Ffrancon on 15 May. A brood of eight further downstream on 17 June was perhaps the same family, and there were broods of three and 10 (free-flying) in Section 4 on the final visit. In 2006 and 2007, adults were still present all along the river except Section 1, but the only broods seen were one (one young) in 2006 and two in 2007 (eight young on 23 May , then two single young on 23 June).

Comparisons of the 2005 to 2007 surveys with those of 1974 and 1975

P. Schofield (PS) carried out an unpublished survey of the breeding birds along the Ogwen in 1974 and 1975, using a territory mapping method similar to that used in 2005-7. It is not possible to make direct comparisons in all cases because of some missing maps and the timing of visits in the earlier surveys, but some changes are apparent (Table 2).

Table 2. Numbers of territories of some riparian species in the two survey periods

Species	**1974/5**	**2005/6/7**
Red-breasted Merganser	Mostly recorded in Section 4 (below Cochwillan Mill), but one pair nested on a small island at the upper end of section 3	2005: 2-3 pairs and 2 broods in the lower part of Section 4, but fewer birds and no broods in 2006/7
Goosander	No records	Breeding as far upstream as Section 2
Moorhen *Gallinula chloropus*	1974: six pairs (four in Section 4 and two in Section 3)	Two records of single birds – Section 3 in 2006 and in Section 2 in 2007
Common Sandpiper	1974: 9 pairs, two of these being in Section 3 (downstream of Nant Ffrancon)	4-5 pairs, confined to Section 2 (Nant Ffrancon)
Kingfisher *Alcedo atthis*	1974: birds seen excavating a tunnel in Section 3	No records
Grey Wagtail	12-14 territories	12-14 territories
Dipper	10-14 territories	14-15 territories

Other species in the Nant Ffrancon (Section 3)

There were changes evident in other non-riparian species in the Nant Ffrancon flood plain. Up to five pairs of Snipe *Gallinago gallinago* were thought to be present in 1974, reduced to a single pair in 2005, based on a chippering bird present. Curlew *Numenius arquata* (one pair in 1974) had disappeared by 2005. Reed Buntings *Emberiza schoeniclus* by contrast, had not declined significantly, with four to five pairs in 1974 and still four in 2005-6, but only two in 2007.

DISCUSSION

Several species have undergone significant changes in distribution on the Ogwen over the three decades since 1974/5. The Goosander has arrived and the Red-breasted Merganser is now only found in the lowest part of the river. The Moorhen has almost completely disappeared; it is possible that this is connected with the arrival of American Mink *Mustela vison* by 2005. Common Sandpipers now have a reduced range on the Ogwen, the upper Nant Ffrancon presumably being the optimal habitat for this species. There were no sightings of Kingfishers in 2005-7, whereas they were seen excavating a tunnel in 1974. The species is regularly present at the North Wales Wildlife Trust's reserve at Aberogwen (adjacent to the mouth of the river) except in the breeding season; where they go to breed is unknown.

Non-riparian species

PS suggested that there were four pairs of Snipe in 1974 but in the recent survey one chipping bird was heard in one year only. PS also noted a pair of Curlew but none were present from 2005 to 2007.

Postscript: No Sand Martins *Riparia riparia* were recorded as breeding birds along the Ogwen during the two survey periods discussed in this paper. It is worth recording that Kate Gibbs found a small breeding colony (about five nest holes) in 2011, in the middle of Section 2. This species is known to move readily between working sand-pits as fresh faces become available, and the 2011 observation shows that they can colonise sections of river-bank in the same way.

The Birds of Denny Island

Richard M. Clarke

Chykembro, 8 Lower Ochrwyth, Risca, Newport NP11 6EN

Denny Island in the Severn estuary Photo: Darryl Spittle

INTRODUCTION

It is probably fair to say that Denny Island (The Denny) is the least known of the islands in the Bristol Channel and perhaps that is not very surprising given its diminutive size and location. The small rocky island does however warrant some consideration as it has a breeding seabird colony that includes cormorants and gulls.

Monmouthshire's only island measures approximately a quarter of a hectare and is located almost mid channel between Magor Pill in Wales and Portishead in England (Grid Ref. ST459810) with its southern edge for the most part lying along the border of the two countries.

Access to the island is difficult due to its very exposed location and the extreme tide ranges in the Bristol Channel and consequently getting there safely requires special boat charter that affords a crew with an excellent local knowledge of tides and conditions. These difficulties have no doubt prevented regular visits being made to the island and consequently many years have elapsed when none were made and this has led to gaps in our knowledge of the status of breeding species between years. In the last decade, however, recording at the island has become more regular and systematic due to the work on ringing seabird pulli undertaken by the Goldcliff Ringing Group.

This paper provides an overview of the breeding birds of Denny Island. It draws from historical records published principally by the Gwent Ornithological Society and, for the last decade, information published by the Goldcliff Ringing Group in their annual reports.

Great Cormorant ***Phalacrocorax carbo***

The chronology of breeding on the island starts in 1963 when a nest believed to be that of the species was found (Boyd, 1963). Thirty years later breeding was once again suspected when 12 juvenile and 50 adult birds were seen on the island in August 1993, but it was not until 1999 that breeding was actually confirmed. The origin of birds at Denny is not clear, but Clarke (2004) postulated that they might have originated from West Wales rather than from Steepholm, as that island's colony had not reached its capacity by the time of the colonisation of the Denny.

From monitoring work undertaken by the Goldcliff Ringing Group, the mean number of apparently occupied nests (AONs) between 2000 and 2011 was 62.8.

Nest numbers between years have varied considerably and details of such counts alongside counts of adult and juvenile birds are shown in Table 1. Such counts show similar trends.

Since 2001, pulli from the Denny have been colour-ringed, which has assisted in increasing the number of birds being subsequently seen. Re-sightings and recoveries provide an insight into dispersal patterns and winter feeding grounds. The majority of birds are noted at inland waters during the winter months: Llandegfedd Reservoir in Gwent, Chew Valley Lake in Somerset, Cotswold Water Park in Wiltshire and the gravel pits near Newbury in Berkshire. Elsewhere birds have been reported along the River Wye and at water bodies in a number of Welsh counties, as well as

Leicestershire, Staffordshire, Buckinghamshire, Oxfordshire, Herefordshire, Sussex, Surrey, the Isle of Wight and perhaps more surprisingly, Stellendam in the Netherlands. Site fidelity is also apparent.

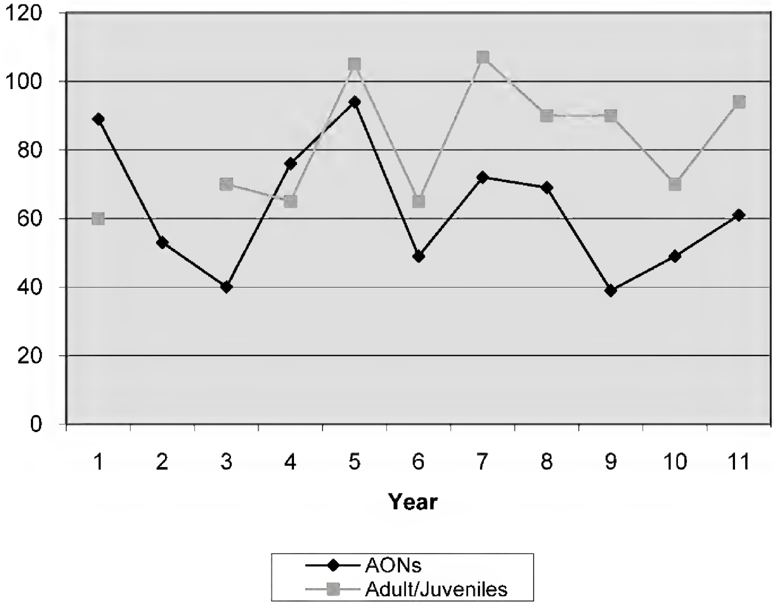

Figure 1. **Cormorant Apparently Occupied Nests and adult/juvenile birds between 2000 and 2011**

Lesser Black-backed Gull Larus fuscus

Very few historical records exist of breeding on the Denny with just two to four nests being noted during 1982-85, however, an absence of visits during the late 1980s and into most of the 1990s means it is not clear what the species' status was at that time (Venables *et al.*. 2008).

There was no evidence of breeding at the island during visits between 2000 and 2009. However, up to three birds were noted during June visits in 2004, 2006 and 2009. After an absence of 25 years, breeding was once again confirmed in 2010 when two pairs were noted and two nests found. Breeding was subsequently recorded in 2011 when one nest with eggs was found.

Herring Gull *Larus argentatus*

The Birds of Gwent states that Denny Island has hosted a colony of Herring Gulls since at least 1961, with numbers of nesting pairs varying between eight and 120 but peaking in the 1970s, and maintained at 70-120 nests/pairs until at least 1981 and then 30-40 pairs being present up to 1985 (Venables *et al.*. 2008).

At the time of the Goldcliff Ringing Group's first visit to the island in 2000 it was apparent that the colony had collapsed with just seven to eight breeding pairs present. These raised between them some 20 juveniles of which 10 were ringed. The colony continued to decline so that by 2002, there was just a single breeding pair remaining and the following year was the first of three consecutive years when no breeding took place. Breeding resumed in 2006 with a single nest with three chicks, but the species was absent once again in 2007.

No visit was made to the island in 2008, but in 2009 three pairs were noted and one nest found with two chicks. Two pairs were present in 2010 and a single nest was found with an egg and two chicks. Then in 2011 three active nests were found, however, one of these had an adult present, which was moribund.

The decline of this once thriving colony could be a consequence possibly of either botulism or the establishment of the Cormorant colony, which has monopolised the limited nesting space on the island plateau (Clarke 2007).

Great Black-backed Gull *Larus marinus*

The species has had a long association with the island with breeding first recorded back in 1954 when a single pair was recorded. The colony increased in size so that by the 1960s and 1970s there was thought to be a mean population of some 34 breeding pairs. A visit back in 1981 (Martin & Venables 1981) recorded that the majority of nests were hidden amongst the dense growth of Tree Mallow *Lavatera arborea* which was prevalent on the island at that time.

No recent nest counts have been made, but based upon the number of adult birds and recently hatched juveniles seen on the island during annual visits over the last decade a breeding population of 20-30 pairs is thought likely (Goldcliff Ringing Group annual reports).

Great Black-backed Gull pulli have been ringed annually on the island since 2000. Despite nearly 200 pulli having been marked, the number of subsequent sightings has been modest. In total, there have been just seven recoveries/ sightings with the majority of these unsurprisingly being from the Bristol Channel area: Gloucester landfill site at Hempsted; Lower Parting, Gloucester; Uphill, N Somerset; and, Great Rumney Wharf near Cardiff.

Intriguingly, however, there have also been two other records of birds noted from further afield at Lyme Regis, Dorset and at Cayeux sur mer, Somme, France. The recovery of a bird in France is unusual in both distance from breeding site (a median distance of 115km is stated in Wernham *et al.* 2002) and location of recovery. To gain a better understanding of the movement of this species from the island a colour-ring scheme is being introduced.

Peregrine Falcon *Falco peregrinus*
The Denny is an historical breeding site for the species with Humphreys (1963) documenting that a clutch of four eggs was collected there in 1927. Subsequently, Ratcliffe included the site in a baseline population estimate for Monmouthshire during the period 1930-39 and also within the territories for the county, either regularly or irregularly occupied in the period 1900 to 1960 (Radcliffe 1980).

There have been no recent breeding records, but some evidence that the species still uses the site, as kills were found during visits in June 2006 and 2011. However, none of these were fresh and the likelihood is that they relate to earlier in the year, possibly as a result of a bird using the island from which to hunt during the winter.

Rock Pipit *Anthus petrosus*
The earliest records are of birds recorded in June 1951 and subsequently seen feeding young in May 1961 (Humphreys 1963).

In 1993 two birds were at Denny Island on 17 August. Breeding was confirmed annually between 2002-2006 on the island, where four pulli were ringed at the nest in 2004 and two pairs were thought to be breeding in 2006.

Carrion Crow *Corvus corone*
Finding this species amongst the seabird colony in 2010 was something of a surprise and even more so when it was realised that breeding had been attempted. Although the actual nest was not found, an adult bird was seen and two freshly dead juveniles were discovered - both were partially eaten. It is assumed that the nest would have been on the ground. In 2011 a pair of adult birds was noted and once again two dead chicks were found.

Other non-breeding species
Not many other species have been recorded on the island, but those that have are listed below: some 30 Mallard *Anas platyrhynchos* were seen flying off the island on 12 June 1981; a dead adult Gannet *Sula bassana* was found on 30 June 2002; a single Turnstone *Arenaria interpres* was seen on 14 June 2003; and, both Oystercatcher *Haematopus ostralegus* and Curlew *Numenius arquata* were recorded on 19 June 2005.

ACKNOWLEDGEMENTS

Regular monitoring of the Denny over the last decade has only been possible with the kind assistance of the Portishead Yacht and Sailing Club.

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Cormorant nest on Denny Island *Photo*: Darryl Spittle

The status, ecology, movements and conservation of Twite *Carduelis flavirostris* in Wales

Ian Johnstone[1], Adrienne Stratford[1], Dewi Roberts[2], Patrick Lindley[1], David Lamacraft[1] and Kelvin Jones[3]

[1] RSPB North Wales Office, Unit 14 Llys Castan, Parc Menai, Bangor, LL57 4FD,
[2] National Trust, Trinity Square, Llandudno, Conwy LL30 2DE,
[3] Browawel, Church Street, Tremadoc, Gwynedd, LL49 9RA,

Summary

1. Following concern for a decline in numbers of breeding Twites in Wales, the aim of this study was to a) estimate population size and trend using new data from 2008, and b) use existing data to describe aspects of their ecology to inform conservation management. We also review existing data on wintering sites in Wales, and present early data from new research on the movements of Welsh-breeding Twite.
2. The 2008 survey estimated 14-17 breeding pairs in Wales; a decline from 26-33 pairs in 2002. Of five occupied 1km squares (in two 10km squares) 80% were wholly or partly in the Snowdonia National Park and under National Trust ownership. Evidence for decline is supported by a significant decline in flock size at the main post-breeding site since 2000.
3. In 2000, post-breeding Twites in Nant Ffrancon were encountered most often in fields containing high densities of seed heads, such as those of Autumn Hawkbit: the plant on which they fed on most often at that time. However, there was a lack of consistency in field use between seasons and years. Between 2000 and 2010, visual assessment of late summer seed-head abundance showed 7% of fields (5.4% of area) showed improvement while 13% (5.9%) showed deterioration. These results are consistent with grazing management affecting sequential seed food sources. 70% of fields surveyed are under National Trust Ownership, and their management is key to providing seed food for Twite.
4. Based on the 2008 survey results, the targeted provision of a weed-rich root crop and supplementary seed feeding station for breeding and post-breeding birds has taken place. These were used, and in 2010 provided the opportunity to begin colour-ring breeding Twites in Snowdonia.
5. Multiple individuals were re-sighted at habitually used coastal sites in North Wales and eastern England in winter 2010/11, and some were re-sighted near their ringing location in spring 2011.

6. There were records of flocks of ≥10 birds from 15 sites along the north Wales coast. Numbers were greatest on the Dee Estuary, which peaked in mid winter but show no trend over time. Key wintering sites should be managed with seed for Twite in mind to maximise the survival of passage and wintering birds.

CRYNODEB

1. Yn dilyn pryder oherwydd lleihad yn niferoedd Llinos y Mynydd yn nythu yng Nghymru, nôd yr astudiaeth oedd a) amcangyfrif maint y boblogaeth a'r duedd gan ddefnyddio data o 2008, a b) defnyddio'r data presennol i ddisgrifio agweddau ar eu hecoleg ar gyfer rheolaeth gadwriaethol. Rydym hefyd yn rhoi arolwg o'r data presennol ar safleoedd gaeafu yng Nghymru, a chyflwyno data o astudiaeth newydd ar symudiadau Llinos y Mynydd sy'n nythu yng Nghymru.
2. Amcangyfrif arolwg 2008 oedd 14-17 o barau yn nythu yng Nghymru, lleihad o'r 26-33 pâr yn 2002. O bum sgwâr 1km ag adar ynddynt (mewn dau sgwâr 10k) roedd 80% yn hollol neu'n rhannol o fewn Parc Cenedlaethol Eryri ac yn eiddo i'r Ymddiriedolaeth Genedlaethol. Atgyfnerthir y dystiolaeth o leihad gan leihad arwyddocaol yn y nifer o adar yn y brif safle lle maent yn ymgynnull wedi nythu ers 2000.
3. Yn 2000, cafwyd hyd i Linos y Mynydd ar ôl nythu yn Nant Ffrancon yn bennaf mewn caeau yn cynnwys llawer o blanhigion a hadau, er enghraifft Peradyl yr hydref: y planhigyn yr oeddynt yn bwydo arno amlaf bryd hynny. Fodd bynnag, roedd amrywiaeth yn y defnydd o gaeau rhwng tymhorau a blynyddoedd. Rhwng 2000 a 2010, casglwyd o amcangyfrif gweledol o amlder planhigion a hadau yn niwedd yr haf fod 7% o'r caeau (5.4% o'r arwynebedd) yn dangos gwelliant a 13% (5.9%) yn dangos dirywiad. Mae'r canlyniadau yma'n gyson a rheolaeth ar bori yn effeithio ffynonellau bwyd yn eu tro. Mae 70% o'r caeau yn yr arolwg yn eiddo i'r Ymddiriedolaeth Genedlaethol, ac mae eu rheolaeth yn allweddol i ddarparu hadau i Linos y Mynydd fwydo.
4. Ar sail canlyniadau arolwg 2008, mae'r targed o ddarparu cnwd yn llawn o chwyn a safle fwydo hadau ychwanegol i adar yn nythu ac ar ôl nythu wedi ei gyrraedd. Defnyddiwyd y rhain, ac yn 2010 rhoddodd hyn gyfle i ddechrau rhoi modrwyau lliw at Linos y Mynydd yn Eryri.
5. Gwelwyd nifer o unigolion eto yn y safleoedd arfordirol arferol yng ngogledd Cymru a dwyrain Lloegr yn ystod gaeaf 2010/11, a gwelwyd rhai eto ger y safle lle gosodwyd y fodrwy yng ngwanwyn 2011.
6. Roedd cofnodion o ≥10 aderyn o 15 safle ar hyd arfordir gogleddol Cymru. Ar aber Afon Dyfrdwy y cafwyd y nifer fwyaf, gyda'r nifer fwyaf ganol gaeaf ond dim tuedd gyson dros amser. Dylid rheoli'r prif safleoedd gaeafu i ddarparu hadau ar gyfer Llinos y Mynydd er mwyn cynyddu'r nifer o adar mudol neu'n gaeafu sy'n byw tros y gaeaf.

INTRODUCTION

The Twite *Carduelis flavirostris* has a wide but fragmented global distribution across Europe and Asia (Cramp 1994). In Britain, the majority of Twites breed in the Highlands and Island of Scotland. Small numbers also breed in the Pennines of England and the uplands of North Wales (Gibbons *et al.* 1993), with both sites at the southern edge of their European range. The Pennines population has been recently estimated as 126-203 pairs (Raine *et al.* 2009), with evidence of decline both here and in Scotland (Langston *et al.* 2006). Twites eat small seeds throughout the year, and unlike many seed-eating farmland birds are not heavily dependent upon invertebrate food for nestlings (Wilkinson & Wilson 2010). They nest in tall vegetation such as mature bracken and heather on steep ground within 2km of seed food sources (Jones 2008). Of population studies in Britain, most show seasonal movements from breeding to wintering quarters (Clark & Sellers 1998, Raine *et al.* 2006).

The history of Twite in Wales is not clear (Lovegrove *et al.* 1994). They were at least present in the north of Wales in the 1800s and were breeding in the early 1900s (the first nest was reported in 1905). After a period of UK wide northward range contraction (Holloway 1996, Langston *et al.* 2006), breeding records in Wales resumed in the middle of the 20th century. Although it has been considered historically absent from Wales (Holloway 1996), and sporadic in Wales since then (Brown 2005), it is more likely a long-established but poorly recorded scarce breeder (Lovegrove *et al.* 1994).

Although the first UK-wide survey in 1999 only found evidence of five breeding pairs in Wales, coverage was incomplete (eight of 12 previously occupied 1km squares based on local knowledge were partly surveyed), and this is supported by records of flocks of 100-200 birds at the end of the breeding season in Nant Ffrancon, at the foot of the Snowdonia hills from where there are previous breeding records (Langston *et al.* 2006). This suggested a breeding population at the time of 20-40 pairs (Green 2000, Langston *et al.* 2006).

In 2002 a Wales survey again took place, although it lacked a formal stratified design. Ninety-five 1km squares with previous evidence of breeding or suitable habitat were collated from a range of data sources and 57 of these were visited at least once. Results suggested a population size of 26-33 breeding pairs in 12 km squares, the majority of which were adjacent to the Nant Ffrancon valley in Snowdonia although survey coverage was again incomplete (most sites only received one visit).

Subsequent post-breeding surveys have suggested that by 2007 post-breeding counts in sites historically favoured by flocks had apparently declined, raising fears for a declining breeding population. Therefore, the first aim of this study was to carry out a repeat survey of breeding and post-breeding Twites in Wales to evaluate population status, and inform conservation action.

In winter, the most reliable sites for Twites in Wales have been the Dee estuary salt marsh and adjacent Gronant dunes (Lovegrove *et al.* 1994), with some monthly maxima exceeding 100 birds (Green 2000), although flocks of 10 or more birds have been reported from a range of coastal sites in North Wales. Elsewhere in the UK, highest wintering densities are found on the east coast from the Wash to the Thames. Although many thousands were counted in the 1980s, this had dropped to less than a thousand more recently (Brown 2005), mirroring the decline of the UK breeding population. A second aim was to review the wintering records of Twites in Wales.

It has been suggested that, like other populations, Twites in Wales leave their breeding sites to winter at lower altitudes, often on coasts where they feed on the seeds of plants including glasswort *Salicornia* spp, Sea Aster *Aster tripolium*, sea-blite *Suaeda* spp and orache *Atriplex* spp (Jones 2008). Foraging conditions on these sites is likely to influence over-winter survival, such that inappropriate management here could negate any efforts to help breeding birds elsewhere. However, although habitually used winter flock sites have been documented in Wales, data explicitly linking Welsh breeding sites with these are lacking. Therefore, a third aim was to report on a new colour-ringing project describing the seasonal movements of Welsh-breeding Twites, so that suitable conditions on their wintering sites can be maintained.

METHODS

Breeding population size

The following sampling strategy based on 1km squares was used. 1km squares with records since 1970 were collated from published and unpublished sources (Fig.1). Using these data and the Phase 1 habitat survey (Howe *et al.* 2005), squares for survey were selected, stratified by three groups. Stratum 1 was full coverage of the 34 1km squares with occupancy since 1970 in Snowdonia (the upland area of northern Gwynedd centered on the Snowdon massif). It is possible that Twites have colonised new breeding sites within Snowdonia. To assess the extent of this, stratum 2 was a random sample of 10 squares with suitable habitat (unenclosed land up to 2.5km from the enclosure boundary and within or overlapping known dispersal distance of 2.5km (Raine *et al.* 2006) from previously occupied Snowdonia squares: N.Wilkinson *pers. comm.*). Twites have previously bred elsewhere in Wales, although recent records are scarce. To evaluate this component of the population, stratum 3 was a random sample of 10 previously occupied squares that were elsewhere in Wales. Any random squares that were ≥75% woodland and/or open water were discarded and replacement random squares selected.

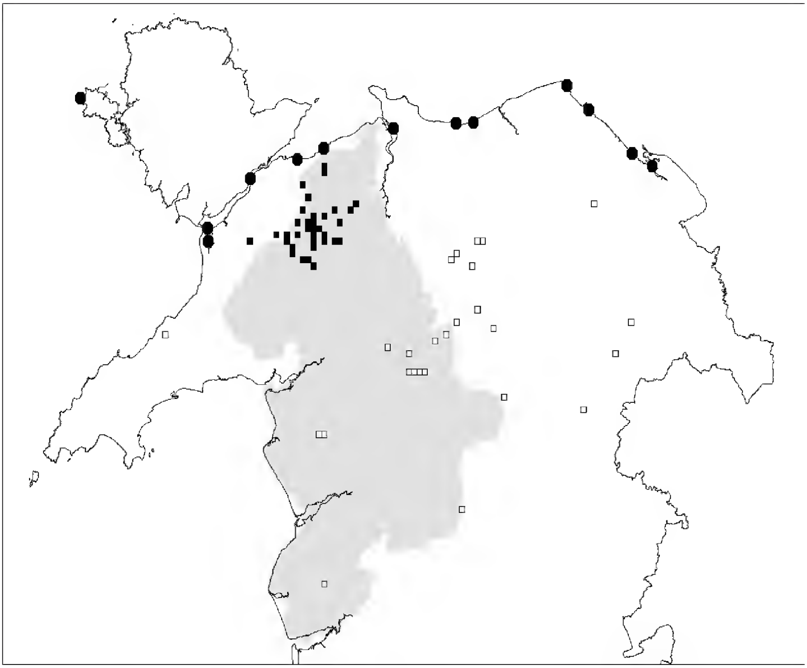

Figure 1. The distribution of 1km squares in Wales previously occupied by breeding Twites since 1970. Black squares are in Snowdonia. Most of these and some records from elsewhere fall in the National Park (grey shading). Three further 1km squares are to the south of this view. Larger black circles show sites with records of ≥10 birds in winter (Oct-Mar). One winter site is south of this view.

Fieldwork was based on the three visit method used by Langston *et al.* (2006). The only departure from this was that only two visits to each square were planned, one in May and one in June with at least two weeks between visits, as this was considered sufficient to detect breeding birds (N. Wilkinson *pers. comm.*) and made maximum use of limited resources. Visits took place between 07.30 and 17.30 hours GMT, but not in winds greater than force 5, persistent rain or poor visibility. All habitats were searched for Twites, excluding woodland, open water and built-up areas. Surveyors followed transects about 200m apart, stopping to scan and listen for five minutes every 100m. Steep scree slopes and crags in squares were also not visited due to concerns for surveyor safety (they were probably not visited in previous surveys), but were watched using the scan element of Langston *et al.* (2006). Records were marked on a large-scale map of each 1km square. For each record, standard BTO codes were used to record breeding activity. In addition, notes were made on the habitat in which records occurred.

Observations at Nant Ffrancon

Systematic field-by-field searches of the Nant Ffrancon area (SH6362-SH6420) using a combination of foot and vehicle transects took place from August to November in 2000, 2002, 2008 and 2010 (start and end dates varied between years), with additional data for May to July in 2002. Some systematic counts of fields east of Llyn Ogwen also took place in 2002 and 2008. All contacts with Twites were recorded on maps, along with group sizes. Individual fields on the transect route were assigned to one of four broad habitat types based on Phase 1 categories. These were farm yards (J.3.6), acid grass (B.1.1: typically the lower slopes of the valley sides) along with a single field of wet heath/acid grass mosaic (D.5), improved grass (B.4: ranging from semi-improved through to heavily improved) and wet pasture (marshy grassland B.5.2 and Fen (E.3). Field areas were measured from the 1:25000 Ordnance Survey map. For large valley-side fields, the area searched was assumed to be that within 100m of the transect route. All other fields fell within this detection distance, but detectability may have differed between broad habitat types.

Direct observation of the seeds Twites were feeding on and vegetation types they were associating with as if feeding were made during transect counts in 2000. In addition, each field was assigned a three-level ‘seed-head score’, based on the apparent abundance of food plant seed heads: present at high density, present, and seed heads absent at time of assessment. However, it should be noted that the presence of food plant seed heads depends on both plant distribution and grassland management (grazing and cutting can remove seed heads). Because grazing was recorded too infrequently (often only for fields that contained Twite on that visit), these variables could not be quantified separately.

Wintering flocks

Winter records (October-March) were collated from County Bird Report records for 1995/96 to 2009/10 (Welsh Bird Reports Numbers 13-23 and Clwyd Bird Report 2009). All sites with flock sizes of >10 were identified. Sites on the Welsh side of the Dee Estuary featured strongly in records, so in addition, maximum counts were collated by month and winter for these sites.

Ringing and Movements

Twite ringing effort in Nant Ffrancon took place from mid April to September, with lower effort during summer when birds were nesting and flocks largely absent. Mist nets were used to catch Twite visiting a seed feeding station. All birds were given a site and year-specific combination of colour-rings that formed part of a UK scheme.

Posters encouraging reports of marked birds were placed at known wintering sites along the north Wales coast, historical wintering sites along the North Wales coast were checked in winter 2010/11, and regular contact was made with bird watchers that concentrated on those sites.

Some birds ringed elsewhere have been re-sighted in Wales. These records contain some information about movements, and are reviewed.

RESULTS

Breeding population size

All squares were visited at least once. Ninety four percent of Stratum 1 squares received two visits, 40% of stratum 2 squares received two visits, while none of stratum 3 squares received two visits. The reason for missing second visits was lack of resources, with effort focussed on stratum 1. Twites were recorded in five 1km squares representing two 10km squares (SH65 and SH66: guidance on the resolution at which new breeding Twite records should be reported indicates a minimum resolution of 10km squares). Four of the 1km squares wholly or partly fell within the National Park, and four were under National Trust (NT) ownership. Records were analysed following Langston *et al.* (2006). The all records method (max. count per square across both visits, where present, divided by two) resulted in a population estimate of 14 breeding pairs, while the flock method (max. count of groups of <5 individuals across both visits), which attempts to excludes non-breeding flocks, resulted in an estimate of 17 breeding pairs.

A further five informal records from four 1km squares were received. Although only one of these records fell during the survey period, interpreting them using the above methods resulted in one additional 1km square containing one breeding pair, also in SH66 (and also within the National Park and under NT ownership). No nests were found, but the behaviour codes associated with Twite records suggested breeding activity in Bracken *Pteridium aquilinum*, tall gorse *Ulex* spp and Heather *Calluna vulgaris* on steep rocky slopes.

Post-breeding flocks

Data on maximum flock sizes in Nant Ffrancon for August-November were analysed in relation to date, date squared (to account for curvilinear relationships) and year of count, using generalised linear models (GzLM). Poisson error structure and a log link function were specified, and the DSCALE option was used to account for any over-dispersion in the data. The minimal adequate model was identified by sequential removal of terms from the maximal model until only terms significant at $P \leq 0.05$ remained based on Type III tests. Models that included year and the interactive effect of count-date and year failed to converge because of the high number of zero counts in 2010 data. On excluding 2010, maximum flock sizes were significantly lower in 2008 than earlier (F_3=29.79 P<0.0001), but the interaction between count date and year was non-significant (F_3=0.79, P=0.4969). Year-specific significant quadratic terms for 2000 (F_1=7.03, P=0.0078) and 2002 (F_1=3.98, P=0.0461) showed that flock sizes peaked in early September at that time (Fig.2). By 2008 and 2010, this peak in numbers was much reduced, such that there were non-significant year-specific effects of count date (P=0.8708 and P=0.3104 for 2008 and 2010 respectively, Fig. 2). In summary, the post-breeding flock size declined significantly in Nant Ffrancon between 2000 and 2008. Some post-breeding Twites were recorded during systematic counts of fields in Nant y Benglog (SH6066-SH6067). However, records fell from a mean of 1.2 contacts per visit in 2002 to zero in 2008.

The plants from which post-breeding Twites were eating seeds were identified on 49 occasions. The frequency with which different plants were used varied (χ^2_8=55.56 P<0.001, Table 1), with a marked preference for the seed heads of Autumn Hawkbit *Leontodon autumnalis*.

Although there were too few data to analyse by month, there was evidence for a shift in diet from hawkbit-dominated in August to a wide range of species by October.

Analysis of habitat preferences using data on the presence or absence of Twites in each field on successive visits in 2000 was carried out using a GzLM. The response variable was the number of visits with Twites divided by the total number of visits, with a binomial error structure and a logit link function. The explanatory variables were: log transformed field area (ha), broad habitat type (four-level factor), and seed food plant presence (three-level factor). The possibility of differences in preferences for seed food plants between broad habitat types was accounted for by including the interaction term between these variables in the maximal model. Type III tests suggested that the probability of Twites being recorded in fields depended on the field area (more likely in larger fields, F_1=13.14 P=0.0003), and the presence of seed food plants (highest probability for greatest abundance, F_2=6.04 P=0.0024, Fig. 3). The effect of broad habitat type was not significant (F_3=0.77 P=0.4624), as was the interaction between this and seed food plant presence (F_5=0.42 P=0.7398).

Table 1. Frequency with which Twites were observed directly feeding on different seed sources and closely associated with and certain vegetation types in Nant Ffrancon in 2000 survey transect counts (number of counts in August n=2, September n=9, October n=6, percentages in brackets). There were no further observations during the single November count.

Common name	Scientific name	August		September		October		Total	
Autumn Hawkbit [1]	*Leontodon autumnalis*	3	(75)	15	(47)	3	(23)	21	(44)
Rush [2]	*Juncus sp.*	0	(0)	5	(15)	1	(8)	6	(12)
Mouse-ear [3]	*Cerastium sp.*	0	(0)	4	(13)	2	(15)	6	(12)
Short acid turf with Tormentil [4]	*Potentilla erecta*	1	(25)	4	(13)	0	(0)	5	(10)
Knotgrass [5]	*Polygonum sp.*	0	(0)	2	(6)	2	(15)	4	(8)
Pineapple Weed	*Chamomilla suaveolens*	0	(0)	1	(3)	2	(15)	3	(6)
Grass sp.	*Graminae*	0	(0)	1	(3)	1	(8)	2	(4)
Self-heal	*Prunella vulgaris*	0	(0)	0	(0)	1	(8)	1	(2)
Sorrel	*Rumex sp.*	0	(0)	0	(0)	1	(8)	1	(2)
		4	(100)	32	(100)	13	(100)	49	(100)

[1] Rough Hawkbit *Leontodon hispidus* also present in small amounts. [2] Birds seen landing in *Juncus* but not directly feeding on seed, although unlikely to be other seed sources present in *Juncus* stands. [3] Two species identified: C. *holosteoides* + *C. glomeratum*. [4] The only seed heads present were of Tormentil and some grass species. [5] Two species identified: *P. arenastrum* + *P. aviculare*.

Table 2. Seasonal change in seed sources used by twite in the UK, adapted from RSPB/EN *unpublished*[1]. Black and grey show high and medium levels of selection

Breeding stage and diet	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov-Mar
Pre-breeding	■							
Breeding		■	■	■	■			
Post-breeding						■	■	
Wintering								■
Purple Moor-grass *Molinia caerulea*	▨							
Annual meadow-grass *Poa annua*	■	▨	▨					
Dandelion *Taraxacum officinale*		■	▨					
Common Sorrel *Rumex acetosa*		▨	■	▨				
Cotton grass *Eriophorum* spp		▨	▨	▨				
Marsh Thistle *Cirsium palustre*			▨	■	■ ▨			
Spear Thistle *Cirsium vulgare*				▨ ■	■			
Creeping Thistle *Cirsium arvense*				▨ ■	■			
Autumn Hawkbit				▨ ■	■			
Arable weeds e.g. Redshank						■	■	■
Marsh Samphire *Crithmum maritimum*								■
Sea Aster								■
Sea blite								■
Orache								■

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[1] RSPB/EN Farmland Advisors Twite Habitat Intervention Handbook.

It is possible that the availability of food plant seed heads are associated with particular habitats, or field sizes. This was investigated using texts of association. There was no evidence of a significant difference in field size between levels of seed plant presence (Kruskal Wallace 1-way ANOVA, χ^2_2=4.0186 P=0.1341). Levels of seed food presence did vary significantly between broad habitat types (χ^2_4=19.39 P=0.0007), although with 44% of cell frequencies less than five, this statistic may be unreliable. The high level of seed head abundance occurred nearly twice as often as expected in improved grass (semi-highly improved), compared with acid grass and wet pasture.

Spearman rank correlation coefficients were use to assess the consistency in the probability of fields being used between 2000 and 2002 for the post-breeding period, and between breeding stages in 2002 (pre-breeding, n=10, breeding n=13, post-breeding n=10). There was no evidence for consistent use either between seasons or years based on these data.

Change in seed head abundance over time was assessed by comparing the numbers of fields with different scores in 2000 and 2010. Results showed that 44 fields (80%, 79% by area) showed no change, four fields (7%, 5.4% by area) showed improvement, while seven fields (13%, 5.9% by area) showed deterioration (Fig. 4). Of the fields surveyed, 70% were under NT ownership, including 100% of the fields with post-breeding high seed head abundance scores.

There were too few records for statistical analysis of habitat preferences in 2008. However, all of four contacts during 10 post-breeding visits were in a single weed-rich turnip crop.

Wintering flocks
Sixteen sites had records of $\geq$10 birds between October and March (Appendix 1). A GLM with a Poisson error structure was used to explain variation in monthly maximum flock sizes within and between winters for sites on the Welsh side of the Dee Estuary. There was a highly significant quadratic relationship between flock size and winter month, with a peak occurring in mid winter (January, $F_{1,47}$=15.42 P=0.0003, Fig. 5). There were too few reported counts in recent years to test for a trend across winters. However, when counts were assigned to *early* and *late* periods (using winter 2002/03 as the last winter of the *early* period with good post-breeding flock sizes in Nant Ffrancon (see Fig. 2), there was no evidence for a significant difference in flock sizes between periods ($F_{1,46}$=0.36 P=0.5509).

Records for the four sites nearest to Nant Ffrancon (Llanfairfechan, Morfa Madryn, Glan-y-Mor Elias and Glan-y-Mor Isaf: Appendix 1), were also collated for the same years (Fig. 5). Although inappropriate for a fitted function, the data clearly show few wintering but a brief early spring peak after which were no records until the autumn.

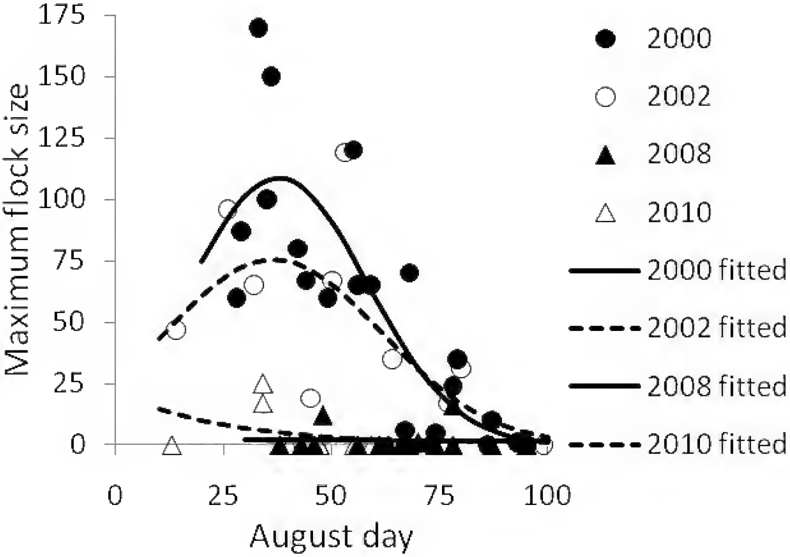

Figure 2. The maximum size of post breeding Twite flocks in Nant Ffrancon, Snowdonia declined through the post-breeding period (day1=1st August) and across years. Data are maximum flock sizes during systematic searches on separate dates. Number of visits=22,10,17 and 9 for 2000, 2002, 2008 and 2010 respectively.

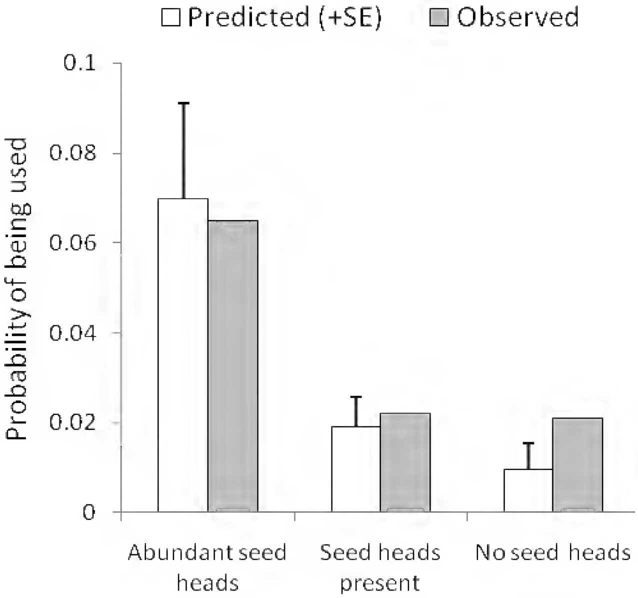

Figure 3. Twites were most likely to be encountered in fields containing abundant food plant seed heads, with predicted use (controlling for the effects of field size) and observed use comparing well.

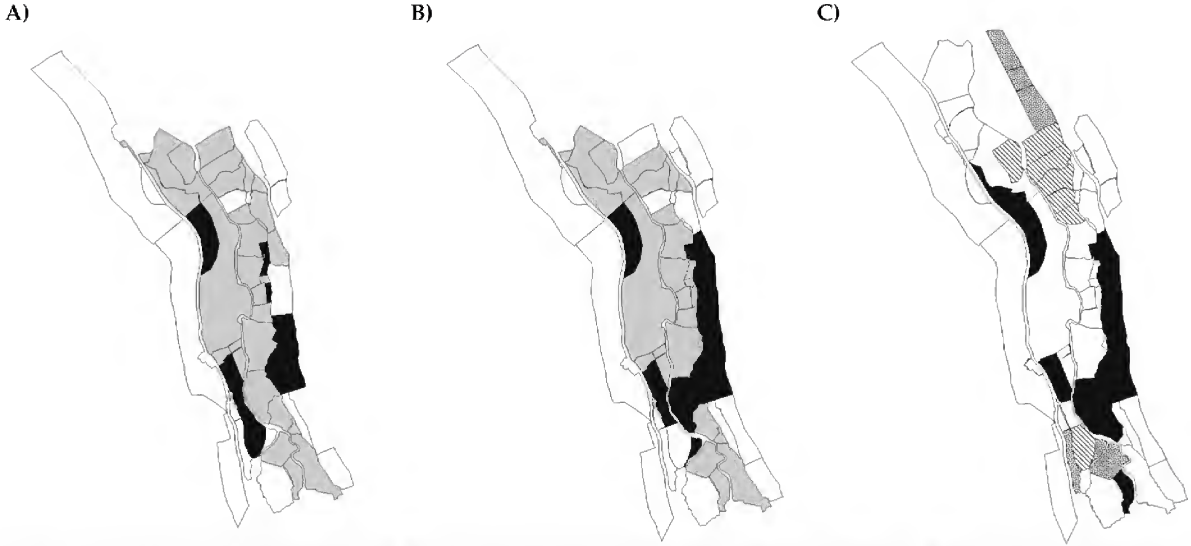

Figure 4. The apparent autumn abundance of seed heads of key food plants by field in Nant Ffrancon, Snowdonia in 2000 (A) and 2010 (B). Black = seed heads abundant, grey = seed heads present, white = no seed heads present. Potential for producing sequential seed sources is shown in (C) based on a visual assessment in 2010. Hatched = potential for flowers found in more intensively-managed improved grassland e.g. spring flowering dandelion and thistle species, black = potential for late-summer/early autumn flowers and Autumn Hawkbit in particular, stippled = locations where arable has been available in the past where it met cross-compliance, and with potential for providing seed food from summer to the following spring (including three fields outside original survey area).

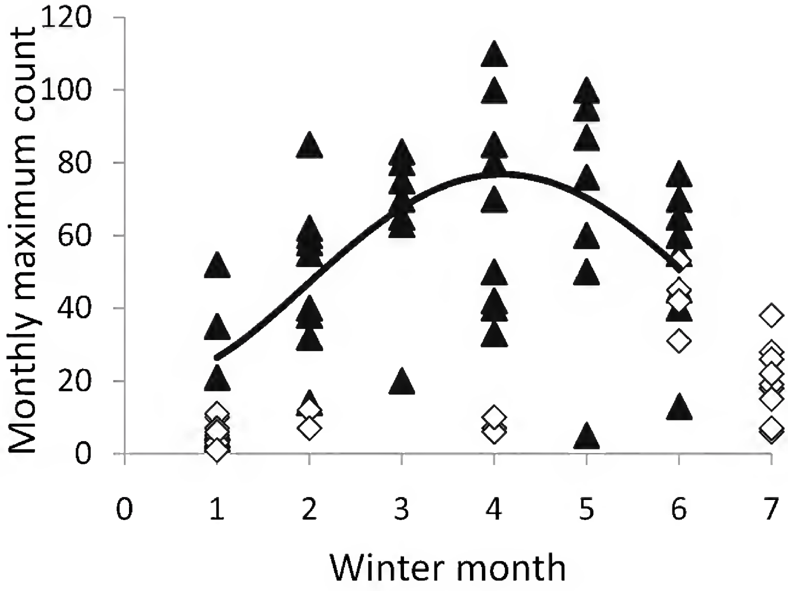

Figure 5. Maximum monthly flock sizes varied through the winter at sites on the Welsh side of the Dee Estuary for winters 1995/06 to 2009/10 (solid triangles) The quadratic function showed a highly significant fit to these data (see text) indicating a mid-winter peak in flock sizes. Records for the four sites nearest to Nant Ffrancon (Llanfairfechan, Morfa Madryn, Glan-y-Mor Elias and Glan-y-Mor Isaf, open diamonds) for the same years show few wintering but a brief early spring peak (there were no records for month 8). Month 1=October and month 6=March

Movements from colour-ring re-sightings

There have been six re-sightings in Wales of Twites ringed elsewhere (Table 3). Four of these were ringed as breeding or post-breeding birds and were wintering in Wales when re-sighted. One may have been of a Welsh breeding bird ringed while wintering in northeast England. One record of a breeding bird on Snowdon ringed in the Pennines may represent either immigration to Wales, or a Wash breeding bird en-route to wintering site.

Table 3. Colour-ringed Twite reported from Wales but ringed elsewhere.

Site ringed	Season ringed	Site re-sighted	Season resighted	Source
Pennines, N. England	Breeding	Flint castle, Dee estuary	Winter 2004/05	Raine *et al.* 2006
Pennines, N. England	Post-breeding	Snowdon	Breeding 2005	Raine *et al.* 2006
Pennines, N. England	Breeding	Madryn, Llanfairfechan	Pre-breeding 2008	Welsh Birds classified records
Lochinver, Highland	Post-breeding	Pensarn, Abergele	Winter 2009/10	Kelvin Jones
Heysham,Lancashire	Winter 2010/11	Nant Ffrancon, Snowdonia	Pre-breeding 2011	Kelvin Jones

Twenty four Twites were ringed in Nant Ffrancon, with a further eight at a North Wales coastal wintering site. By spring 2011 birds bad been reported from two sites: Oakenholt near Connah's Quay on the Dee Estuary (several individuals) and Tichwell in North Norfolk (repeated sightings of two individuals.

DISCUSSION

Breeding population status

At the last revision, the population status of Twites in Wales was changed from amber to red on the basis of the 2008 breeding survey results (severe decline in range over 25 year and longer-term periods, marginally failing to qualify on severe decline in breeding numbers over 25year period) (Johnstone *et al.* 2010). For the UK as a whole, Twite has always qualified for the red list on the basis of historic decline, and most recently on severe decline in breeding numbers over 25 yrs based on a BBS index using a small sample size (n=22) (Eaton *et al.* 2009). Twite was also listed as a Principal Biodiversity Species in 2008 under Section 42 of the Natural Environment and Rural Communities Act (**http://www.biodiversitywales.org.uk/species-35.aspx**) because of its range decline in recent years and the UKs responsibility for its international population, and the National Trust (NT) and RSPB are lead partners. Furthermore, an SNPA Biodiversity Action Plan has been produced for Twite (**www.eryri-npa.gov.uk/conserving/biodiversity-in-snowdonia/snowdonia-biodiversity-action-plan**), and this report contributes towards meeting objectives 2 and 3 of this.

Trend in breeding and post-breeding numbers

These results suggest a decline in breeding population size. However, because not all of the two visits were completed in 2008 and particularly in 2002, the magnitude of this trend should be treated with some caution. Nevertheless, the direction of this trend is supported by the downward trend in post-breeding flock sizes in Nant Ffrancon since then.

The latter is unlikely to simply reflect shifts in range of post-breeding flocks of historic sizes as other nearby areas (Tryfan, Nant Y Benglog) were formally searched as recently as 2008 but contained no Twite. Although not the easiest bird to identify, Twite have been a priority species in Wales since 2008, and important post-breeding flocks seen elsewhere in Snowdonia are likely to have been reported. Nevertheless, other unreported post-breeding sites do remain a possibility.

The habitats containing birds showing evidence of breeding were consistent with the nesting habitats reported elsewhere (e.g. Jones 2008). These habitats are abundant in Snowdonia and there seems no reason to think availability of nest sites *per se* is limiting the population size, although the proximity of suitable nesting habitat to seed-rich feeding areas could be.

Breeding and post-breeding habitat preferences

The preferences for fields during the post-breeding period showed a good match to the highest densities of food plant seed heads, suggesting this determines where Twite feed. It is likely that this also determine feeding sites preferences at other times of year, so management that provides a succession of sources of small seeds is essential. Seed heads can be prevented from developing or once developed be rapidly removed through grazing or cutting. Past data were too incomplete to examine separately the effects of seed head density and grazing or cutting, but given the livestock farming systems in Snowdonia, favourable grazing management in fields where the different plants that provide successive seed-sources (Table 2) occur at high densities is likely to be key to its suitability for successfully breeding Twites.

There are two possible reasons for the lack of significant habitat associations at this time. First, Twites may be selecting specific degrees of improvement of pasture which are not resolved by the Phase 1 categories. Second, although fields were assigned to single majority habitat types, some containing several types, and Twites may have selected a minority habitat, which would not have been reflected in the analysis.

Arable crops can provide abundant seed food for Twite (Carke & Seller 1996, Hancock & Wilson 2002), and Nant Ffrancon has often contained arable fodder crops such as roots in the past. They were managed in a way that promoted weed seeds: establishing by cultivation and not using herbicides. Furthermore, the turnip crop established in this way 2008 proved highly attractive to Twite.

The lack of consistency in field use between breeding stages and years may indicate that successive seed sources are associated with plants with different distributions in Nant Ffrancon, and that seed production is also influenced by rotational management across years. Furthermore, the distribution of the same seed food plants may vary between years in response to climatic or management variables. This would mean that beneficial management would need to take place on different fields at different times through the year to provide a continuous supply of natural seed food. However, the needs of the current population only require small areas to be under favourable management, which can be achieved in the smaller fields, or the temporary fencing of field margins or corners.

Wintering and passage population

Evidence from County Bird Reports identifies a range of coastal flock sites, with a clear concentration along the North Wales Coast. The counts are highest for those sites on the Dee Estuary, which peak in mid winter. These data are consistent with a regular movement from Snowdonia breeding sites to the Dee. Indeed, there is a brief surge in numbers at sites near Llanfairfechan in April, presumably as wintering birds make their way westwards along the coast to this site and then upwards to higher altitudes in Snowdonia when weather conditions are suitable. The absence of a similar autumn peak, when numbers are expected to be higher, may indicate that birds leave breeding sites over an extended period, birds move away to wintering areas more quickly as they are not limited by weather, or that these sites have little available seed at this time. Alternatively coverage of these sites by bird watchers is less in the late summer and autumn than the spring.

However, although flock sizes in recent winters are broadly consistent with the estimated Welsh breeding population size, because there is no evidence for a decline in maximum counts on the Dee sites, and occasional records of marked birds from breeding populations in the English Pennines and northern Scotland (Table 3), this wintering population is unlikely be made up solely of Welsh breeding birds. Nevertheless, the lack of evidence for decline on the Dee sites may be because bird watchers are less likely to report zero counts on known wintering sites. It is important that regular counts of wintering Twites take place between September and April on coastal site in north Wales, which should also include records of absences from regular sites.

Although based on only one year of ringing, movements have been larger than expected. Nevertheless, such movements are largely consistent with the sizes of movements of birds ringed outside Wales but reported from here (Table 3). It is interesting that birds from Wales are crossing England, and there remain questions as to the route taken, rapidity, regularity and duration of these movements. Re-sighting data from this site and year-specific scheme provide valuable information on movements.

Taken collectively, these early results suggest that Twites breeding in Snowdonia appear to winter in flocks containing English breeding Twites. It may be advantageous that this rare breeding bird in Wales has a mobile winter population that can respond to spatial and seasonal variation in seed abundance, especially if wintering flocks act as information centres (Ward & Zahavi 1973). Furthermore, this mixing raises the possibility of gene flow between UK breeding populations which will increase population viability across a fragmented breeding range (Leburg 2005), indeed there may already be evidence of this from a presumed Snowdonia breeding bird originally ringed in the Pennines (Table 3).

Much is already known of the winter habitat preferences and diet elsewhere in the UK. Sea-lavender *Limonium* spp and sea-blite/glasswort saltmarsh communities were selected on the north Norfolk coast (Brown & Atkinson 1996), who used vegetation categories from the saltmarsh of Great Britain survey (Burd 1989). The seeds of seashore plants including glasswort spp, Sea Aster, sea-blite spp and orache spp are important components of winter diet in their English wintering range (Jones 2008). In Scotland, seeds in arable crops such as oat and rape stubble along with post-grazing fodder crops are selected in addition to coastal habitats (Clarke & Sellers 1996, Hancock & Wilson 2002). There are no data on habitat preferences or diet of Twites wintering in Wales, and there is scope here for further data collection on habitat preferences and diet along with threats to and scope for improving habitat condition on known wintering sites.

The conservation of Twite in Wales

Nature conservation action should be evidence-based to maximise impact and cost-effectiveness. In the case of Twite, there is evidence for breeding population decline, reduced post-breeding flock sizes, and movement between geographically separate breeding and winter quarters.

The best methods of diagnosing the cause of this decline would be to measure demographic rates (e.g. breeding success and survival), or to relate differences in population growth to differences in management between populations (Green 1994). However, these are not possible with existing data. Indeed, the low number of pairs, likely inaccessibility of nest sites and only slight age differences in post-breeding plumage make measuring these very difficult, although, ringing may allow the ratio of adults to young to be estimated along with return rates of marked birds, which may provide some information on breeding success and survival.

Nevertheless, a precautionary approach to management can still be taken. This requires as many perceived ecological problems as possible to be addressed. For example, conservation management for Cirl Buntings *Emberiza cirlus* has been a success (Peach *et al.* 2001) despite no study formally identifying any single most limiting factor. Instead, implementing prescription to improve habitat quality during both breeding and winter, based on studies of the birds' ecology, resulted in a population increase relative to places where they were not implemented.

Such an approach for Twite in Wales is possible, informed by Wales-specific evidence for ecological requirements (for example during the post-breeding period), augmented by the results of studies of populations elsewhere in the UK. The needs of Twites and action to deliver them are summarised in Table 4 and expanded on here.

1) Nest site availability

Although no nests have been found in Nant Ffrancon, the habitat occupied by birds suggests breeding behaviour is the same elsewhere in the UK, where Twite nest in stands of mature heather and bracken on steep slopes (Jones 2008). The mountain pasture around Nant Ffrancon has been subject to changes in grazing management to promote heather recovery, and there seems no reason to think the heather nesting habitat has deteriorated since 2000 as a result of this. However, as Twite also nest in bracken stands the control of bracken, either directly through spraying, or indirectly e.g. by tree-planting could have an impact on nest site availability. The planting of trees can have a further negative impact given that Twites avoid tree cover. Although this has taken place in Nant Ffrancon, to date it has not taken place in areas where it is thought to have had a negative impact on Twite.

There are too few pairs remaining to directly estimate nest success and re-nesting probabilities (up to three broods are possible). However, it may be possible to indirectly estimate breeding success using the ratio of adults to fledged young during the post-breeding period, and changes in this across years may prove a measure of the success of interventions to improve breeding success.

2) Managing for seed food pre-, during and post-breeding

In Nant Ffrancon, breeding Twite likely depend on a successional supply of seed food from their return in spring until post-breeding flocks disperse in autumn as they do elsewhere (Wilkinson & Wilson 2010). The availability of this food is most likely to be influenced primarily by two mechanisms: 1) grassland management and 2) arable management within the existing beef and sheep livestock farming systems of the area. Furthermore, seed sources need to be close to nest sites (2km: Raine 2006, 1.6km: Wilkinson & Wilson).

Table 4. Species needs, potential limiting factors on Twite population growth rate, evidence for limitation by each in the Welsh population, and steps required to alleviate them.

Species needs	Potential limiting factor	Evidence for limitation in Wales	Steps required
Mature Heather and Bracken on steep slopes for nest sites	Reduced quality of nesting vegetation through: Overgrazing on unenclosed land Heather burning/bracken control Tree planting	Grazing already reduced through Tir Gofal Bracken control a threat Some tree planting already and future threat	No action on grazing Advocacy on threats
Sources of seed food for adults and chicks within 2km of nest sites during breeding	Stocking densities too high or grazing breaks too short to allow seed set in enclosed fields Loss of alternative seed sources created by extensive agricultural systems (e.g. hay-fed out-wintered cattle, hay, arable)	Use of feeding station suggests other seed sources less profitable Anecdotal observation of twite feeding where out-wintered cattle were kept	Continue feeding stations Identify flower-rich fields and deliver sequential grazing agreements
Seed food for post-breeding flocks in Nant Ffrancon	Stocking densities too high or grazing breaks too short to allow seed set in enclosed fields Loss of alternative seed sources created by extensive agricultural systems (e.g. hay, arable)	Use of feeding station suggests other seed sources less profitable Anecdotal observations of rapid seed head removal by livestock	Continue feeding stations Identify flower-rich fields and deliver grazing agreements Deliver arable agreements
Food during winter and passage	High stocking densities prevent seed-set on saltmarsh, disturbance, abandonment of unfarmed land leads to loss of preferred seed plants, lack of fresh water	No data	Assess food sources on sites with $\geq$10 birds

There has been little further intensification of grassland by re-seeding, and in the absence of formal botanical survey the distribution and density of food plants appears to have been broadly stable since 2000 (Fig. 4).

However, there has been management change over a longer time-scale. For example, changes from beef and sheep systems to sheep only. Fields where cattle were out-wintered used to provide feeding habitat for Twite in the spring, where it is assumed that they were feeding the seeds of annual plants such as annual meadow grass *Poa annua* and seeds hay. This practice ended in the mid 2000's and, although spring survey coverage at this site has been patchy, Twites have not been recorded feeding in these fields since. Efforts are underway to reinstate hay production within the valley.

Some fields in Nant Ffrancon contained high densities of Autumn Hawkbit: in 2000 the most favoured food plant during the post-breeding period. However, the availability of their seed is heavily influenced by grazing. Although grazing is essential as it reduces the dominance of more competitive grasses, it can also completely remove the flowers and seed heads and subsequent seed supply if allowed at the wrong time. Stock-type may also have an effect, with sheep more likely to select flowers than cattle (Crofts & Jefferson 1999). Therefore, grazing management is crucial in providing a successional supply of seeds for Twite. Candidate AES options include pulse grazing and extended grazing breaks on fields with high densities of flowers until seasonal use by Twite has passed. The few remaining Twite do not need extensive areas under favourable grazing, so small fields or the temporary fencing of field margins or corners will suffice.

However, evidence of variation in field usage between seasons and years suggests that widely distributed key plants can provide seed when management allows, and that the birds can find new seed sources rapidly, so targeting management to previously used field should not be necessary, maximising the flexibility in combining Twite needs with viable agriculture.

Twites readily use small seeds, such as Nyjer, when provided at feeding stations, and this has attracted feeding birds during both breeding (Nant Ffrancon in Snowdonia and English Pennines) and non-breeding (e.g. Heysham in Lancashire and Tichwell in Norfolk). There is scope for more feeding stations to be established so that all recent breeding records are within 2km of such stations. However, whilst such food provision may be warranted in emergency recovery situations, it should not be though of as sustainable conservation management. However, there is some evidence that Twites prefer to use natural seed during chick rearing (Raine 2004), either because it is more profitable (e.g. closer to nests) or of better nutrition. Therefore, feeding stations should only be seen as a short-term measure until natural seed sources have been delivered through agricultural management.

In 2008, Twite flocks were recorded feeding in weed-rich turnip crops provided under the Tir Gofal Agri-environment scheme. Since then, unsprayed root crops established by ploughing have been present in some years, but not all. Concerns over soil erosion issues can be addressed by positioning crops on level fields above areas of seasonal flooding and using grass margins between crops and water courses (Fig. 4).

3) Winter flock sites

The current suitability and management of the north Wales passage and wintering sites for Twites is currently unknown, even though some sites are on nature reserves. A reassessment of this informed by the salt marsh survey of Great Britain (Burd 1989) would be valuable.

There is a need for more records of breeding and wintering Twites, including those indicating an absence from known sites (Appendix 1). Any colour-ringing birds should be reported to Kelvin Jones, Bird Track or Country Bird Recorders. These data will help determine the importance of individual sites and the routes taken to or from breeding sites.

Next steps

Twites already use the feeding station, suggesting natural seed sources are less profitable than this at times. The supplementary feeding project should be extended to achieve at least one feeding station available within 2km of all suspected nesting areas to maximise access to food in the short term.

In the medium term, work with land managers to provide a succession of seed sources throughout the pre-breeding, breeding and post-breeding periods, located as widely as possible within the Nant Ffrancon valley. Novel approaches such as grazing breaks and margins/corners should be trialled and adequately monitored. As guidance, fields with the potential to deliver food at different times of year have been identified based on a visual assessment in 2010 (Fig.4). If numbers of Twite make it feasible, collect data on Twite occurrence, seed head abundance and agricultural management to measure habitat preferences and response to management agreements throughout the period Twites are present in Nant Ffrancon.

Continue ringing efforts throughout the breeding and post-breeding periods, taking any opportunity to age individuals to calculate ratio of adults to young as an indirect measure of breeding success. Encourage records of Twites from anywhere in Wales, including records of absence from known wintering sites, and colour-ring sightings.

Carry out formal assessments of food plant distribution in Nant Ffrancon during the pre-breeding breeding and post-breeding periods to improve the current guidance. Extend this to assessments of known wintering sites.

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Appendix 1: Wintering sites of Twites in Wales with ≥10 birds 1995-2010

Grid Ref	Name	Area
SH6172	Aber Ogwen	Menai Strait
SH4461	Abermenai point	Menai Strait
SJ2871	Oakenholt near Connahs Quay	Dee Estuary
SH7977	Conwy RSPB	Conwy Estuary
SJ2473	Flint Castle marsh	Dee Estuary
SH4459	Foryd Bay	Menai Straight
SH6172	Glan y Mor Isaf	Menai Straight
SJ9997	Horton's Nose	Rhyl
SH9178	Llandulas Beach	Colwyn Bay
SH6674	Llanfairfechan/Madryn	Menai Straight
SJ1680	Mostyn Dock	Dee Estuary
SH9478	Pensarn	Rhyl
SJ1284	Point of Ayr	Dee Estuary
SH2082	South Stack	Anglesey
SM7227	St Davids Head	Pembrokeshire
SH5269	Plas Newydd	Menai Strait

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